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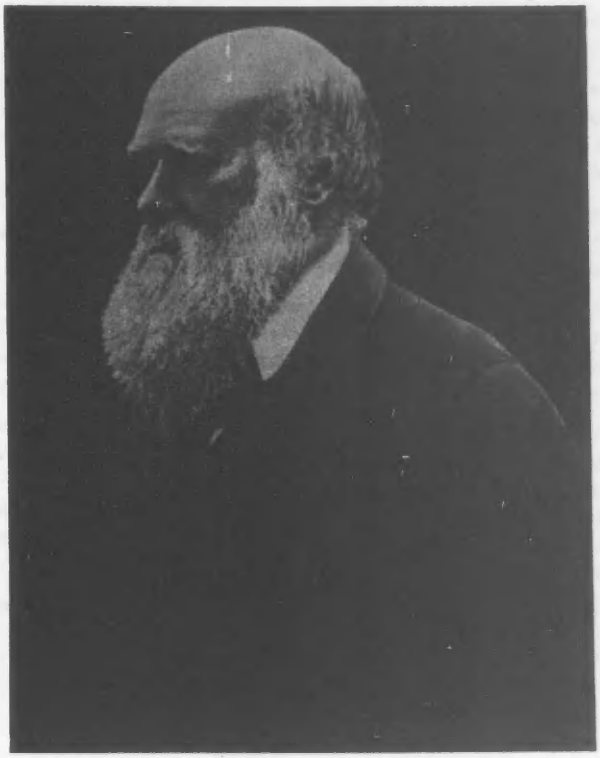

ON THE 100TH ANNIVERSARY OF THE PUBLICATION OF "THE ORIGIN OF SPECIES" BY CHARLES DARWIN.

Academician E. N. Pavlovskii

In 1958 the centenary of the publication of "The Origin of Species" by C. Darwin was commemorated and also an announcement on the same subject by A. Wallace. As is well known, observations on insects provided Darwin with much of the material required for elaborating his evolution theories. Certain parts of his work are almost entirely concerned with insects, for example, those devoted to the interrelationships of insects with flowers, problems concerning their mutual adaptations to one another, and the development of the incredible mechanisims for transmitting pollen from one flower to another. In addition, the study of the cycles of insect mimicry, carried out by Wallace in the Malay Archipelago, was also a clear illustration of the evolution of species in a definite direction. The historical importance of Darwin's theory is, indeed, not overestimated. For the first time in history thousands of phenomena, formerly inexplicable, were adequately explained, and into the hands of the most remote investigator came the chances, not only of understanding the biological world around him, but of securing the opportunity of its rational reorganization.

For 100 years, since the publication of the first announcement of the origin of species, the evolutionary studies of Darwin have become one of the foundations of biological science, in particular, entomology. The evolutionary basis, together with the extension of research methods and factual knowledge, acquired all the more importance in the development of theoretical entomology as well as its application to practical life. The species

problem and the problems of evolution form the base of very many researches in the field of entomology; in particular, the whole of systematics – one of the most extensive fields of entomology – should not be pursed without a wide evolutionary knowledge, and at the same time, systematics greatly extends this evolutionary knowledge, one might say, with each year and with each new work.

Our entomological society appears to be about the same age as evolutionary Darwinism: In 1960 it commemorates its 100th jubilee. During these past 100 years much has been accomplished in the field of evolutionary teaching in biology at home, especially in the field of entomology; here one can recall the names of K. M. Béra, I. I. Mechnikov, I. A. Parchinskii, N. A. Kholodkovskii and many others.

In addition to this, mainly through systematics understood in its widest sense, evolutionary instruction has a direct influence on many sections of so-called applied entomology the importance of which, in the life of the state, is expanding more and more with the development of our knowledge.

The general plan of our work over the next seven years, embracing the whole structural life of our country, presumes the development of extensive theoretical researches into many regions of science, particularly in biology, and also the expansion and strengthening of the bonds between science and the most immediate demands of life. In this notable plan investigations into evolutionary entomology find their own place.

There is no doubt that the progessive ideas of Darwin's evolutionary doctrine find their greatest development in our country which can be truly proud of the contributions which its countrymen have made to this study. In this direction a great deal has been done by the entomologist. One ought not to forget that the development of the resources of the animal world in our country and its utilization entered into the Sever Year Plan as one of the fundamental problems of state importance. Many aspects of this program of work cannot be carried out without an intensive application of the data from evolutionary science.

In connection with the centenary of evolutionary teaching, the All-Union Entomological Society dedicates the present issue of its journal to the memory of the great naturalist Charles Darwin.

INITIATION AND EVOLUTION OF THE CHANGE OF HOSTS AND DIAPAUSE IN PLANT LICE (APHIDIDAE) IN THE COURSE OF THE ADAPTATION TO THE ANNUAL CYCLES OF THEIR HOST PLANTS

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The ideas developed by Charles Darwin in "The Origin of Species" initiated many excellent pieces of research work which were permeated by the spirit of evolution.

The remarkable work of one of the early investigators – that carried out by A.K. Mordvilko (1901) – was devoted to the morphology and biology of aphids in connection with their living conditions. With great perspicacity the evolutionist Mordvilko discovered the nature of such phenomena as the change of hosts and the summer diapause in the adaptation of aphids to the seasonal changes in their host plants.

Experimental researches of the twentieth century have produced a large number of facts confirming, as well as contradicting, Mordvilko's opinions. This conflicting evidence in experimental data is, to a considerable extent, the result of the notorious empiricism of former times and an underestimation of the evolutionary approach to scientific problems.

Nevertheless, in recent times research workers have come to recognize the ancient causes for the change of host plants which is connected with seasonal changes in woody plants, and also determine the more recent ones which regulate it (Bonnemaison, 1951; Kennedy and Booth, 1954; Shaposhnikov, 1955). Consistent inquiry into this opinion allows one to dispose of the apparent contradiction and to explain satisfactorily all the accumulated facts connected, not only with the change of hosts, but with diapause also.

In the evolution of the majority of the groups of aphids two different trends are characteristic: On the one hand, continuous, deep speciation on a strictly determined range of hosts; on the other hand, migration of specialized forms onto new hosts which, as a rule, are systematically and ecologically distant from the preceding ones.

The change of host plants and, in particular, heteroecy brings with it the production of new species; this, undoubtedly, is the most common method of evolution among aphids. It is linked with the migration of aphids from plants which are older in the scale of evolution on to more recently evolved plants, for example, from trees and shrubs to herbaceous plants.

Hence, a question arises which is exceedingly important for aphidology: The formation of species in connection with change of hosts. This question demands resolution into several parts: (1) causes of the migration of aphids onto new hosts (Shaposhnikov and Eliseev, 1959; the present article), (2) conditions for the development of adaptations to new hosts and especially the change of specificity (Shaposhnikov, 1959a) and (3) the part played by the change of hosts in the formation of aphid species (this question is elaborated).

These three questions demand a broad evolutionary approach with a combination of methods involving systematics and experimental ecology.

The experimental work was carried out in 1954-1957 in the Maikop district experimental station of the All-Union Institute for Plant Production, on the Shuntuk farm at the foot of the N. Caucasian hills. The author was assisted in his work by E.V. Garnovskaya who, in addition to her daily technical duties, carried out estimations of the concentration of plant sap.

MATERIALS AND METHODS OF RESEARCH

The principal insects used in this research work were a group of aphids from the vast polymorphous genus Dysaphis CB, s. lat. The species of this group (subgenus Dysaphis CB, s. str.) are closely related morphologically and sometimes one can hardly be distinguished from another: Among them are diapausing as well as heteroecious species which possess a rigid timing to definite hosts and, according to their life cycles, present, as it were, different degrees of migration from primary to secondary hosts. The economic importance of these aphids as serious pests of apples and the inadequacy of the existing measures of control account quite clearly for the practical interest shown in these insects.

Four heteroecious forms were experimentally studied: D. anthrisci anthrisci CB, D. anthrisci chaerophyllina Shap., subsp. n., * D. chaerophylli CB and D. radicicola Mordy.

The most important experimental condition in the present investigation was the constant combination and, as far as possible, duplication of observations made in nature with laboratory and field experiments on pure cultures of aphids.

For obtaining cultures known to be pure, that is, isolated clones (stem, line), single fundatrices were used and, subsequently, all its descendants were strictly segregated. For isolating the aphids on apples in the field, transparent celluloid cylinders, 8 cm in diameter and 22 cm long, were used, and these isolators were closed at one end by a removable cover made from bolting silk, No. 36-38; at the other end a bag 22 cm long, also made of bolting silk, was attached. The cylinder was tied carefully to the shoot so that by removing the cover the shoot could be pushed forward out of the cylinder for more careful examination and for removing aphids. The cylinders used on the laboratory were of two sizes according to the size of the shoot upon which they were used; 8 and 11 cm in diameter and 32 cm long. Bolting silk was used because small aphid nymphs and small chalcids could not penetrate it.

Pot cultures of apples and secondary host plants were used in the laboratory experiments in which soil and plants were not strictly uniform. Fluctuations of temperature and humidity of the air and also the watering of the plants were identical in all experiments, and controls were simultaneously carried out.

When setting up the experiments the plants were carefully examined by a magnifying glass (x10) and all insects found on them were killed. Aphids were generally transferred singly from one plant to another by means of a soft, thin, lightly moistened brush but occasionally in whole colonies together with pieces of plant tissue.

Observations were made on the apples every 5-7 days, but each day when necessary; secondary hosts were examined every day.

The aphid species were identified by the apterous individuals feeding on the secondary hosts.

The plants used as secondary hosts were young and vigorous. The experiments carried out on them were always replicated (from 2-10 reps), generally in triplicate. If the aphids died in any one replicate they were replaced by aphids transferred from other replications. In order to trace and record a whole series of generations of fundatrigenia the adults of each generation, as soon as they had produced 30-40 nymphs, were recorded and utilized in other experiments, together with a number of the original nymphs, 10 (in 1954-1956) or 25 (in 1957), which were still kept on the plants for further development and multiplication.

* The described morph (subspecies?) differs from D. anthrisci anthrisci CB, taken from the same locality, by the weaker scleritization of the tergites in the apterous fundatrigenia, the lesser number of upper marginal hairs on the 5th abdominal tergite in the 1st stage nymph, considerably larger number of apterous individuals in the 2nd generation, migration to Chaerophyllum maculatum, but not to Anthriscus; and this is for any female of the subgenus, although, under experimental conditions they pair with females of another subgenus but are not fertilized by them, except on very rare occasions.

TABLE 1

Concentration of Sap (in percent) in Sound Apple Leaves and in Galls (1956)

Date	Galls of first generation	Corresponding portion of attacked leaf	Galls of second generation	Corresponding leaf	Young leaves	Adult leaves
26 IV	10.1	11.7	—	—	7.1	—
6 V	13.3	18.5	10.4	14.0	13.7	15.9
16 V	10.7	11.9	8.4	11.1	9.1	11.4
27 V	17.4 *	—	13.0; 15.6 *	17.8	13.5	15.6
8 VI	—	—	16.9 *	17.9	14.0	16.7
18 VI	—	—	22.6 *	22.7	19.6	22.9
29 VI	—	—	—	—	13.6	16.5
9 VII	—	—	—	—	19.2	19.4
18 VII	—	—	—	—	19.0	23.9
28 VII	—	—	—	—	16.5	18.5

*Galls already forsaken by aphids.

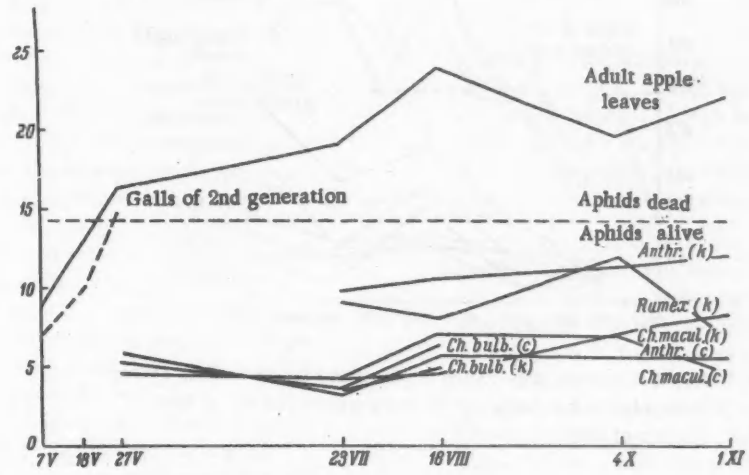

Fig. 1. Concentration of sap of plants in percent (1955). r) Root; s) base of stem.

The concentration of plant sap was determined by the assistance of a laboratory refractometer which gave the percentage of dry matter in the reduction to sugar. As a rule, samples of leaves were taken from one and the same control tree so that in one sample there were many leaves (20-40) of one type, or parts of them, which meant that the analytical results were always averages. Inasmuch as it was impossible to determine the aphids on apples in the field their galls were roughly analyzed without taking into account the individual species.

Life Cycle of Aphids of the Subgenus Dysaphis CB. s. str.

Aphids belonging to the subgenus Dysaphis, like the overwhelming majority of aphids in general, hibernate in the egg stage.

The emergence of the fundatrix on the apple generally coincides with the bursting of the buds. According to the data of Smirnova (1957), in D. devecta Walk. in Michurinsk, emergence begins on the apple with a rise in average daily temperature to 13°, with a minimum of 5°, and may coincide with the green cone phase, the protrusion of the inflorescence or even its bursting.

After hatching from the egg the nymphal fundatrices feed on the lower surface of the tips of the unfolding leaves, as a result of which this portion of the leaf is converted into a covered gall of a cherry-red color. Only

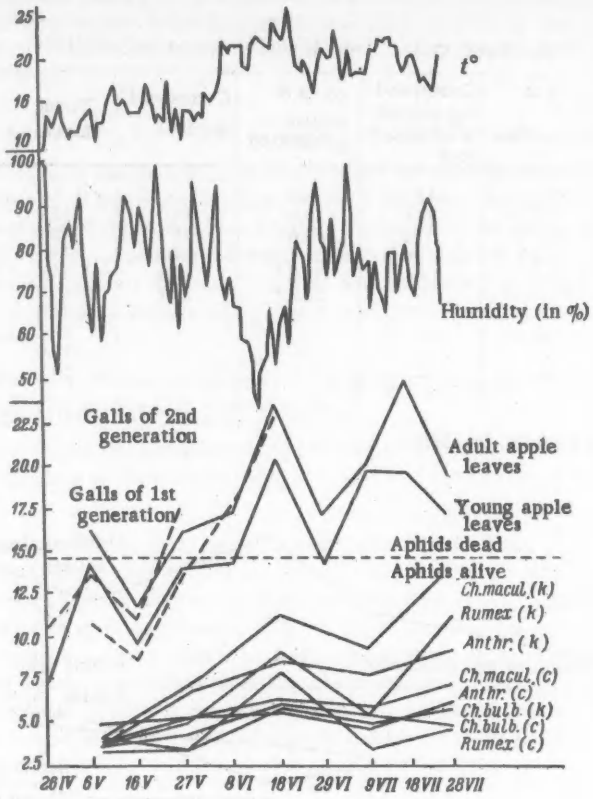

Fig. 2. Concentration of sap in plants in percent and the average daily relative humidity and air temperature (1956). r) Root; s) base of stem.

the 1st stage nymphs can form galls. Thus, 39 fundatrices of a. anthrisci, a. chaerophyllina and radicicola, which had already formed galls, were transferred at the end of April 1956 on to another tree where they became acclimatized. Among these aphids were 3 1st stage nymphs (a. chaerophyllina) and all three caused the formation of galls; some hint of a gall was produced by one of the 2nd stage nymphs; no galls were produced by any of the other aphids although the fertility of certain among them was only a little lower than in the galls.

The fundatrices and the aphids of the following generations are able to feed and develop normally on the wild apple (Malus orientalis Uglitz.) as well as on the cultivated varieties (Malus domestica Borkh.). The fertility of the fundatrices, reaching 150 nymphs or more (in a. anthrisci and a. chaerophyllina), depend to a large degree on feeding conditions.

The generations following the fundatrices produced covered galls, as a rule, on the lateral parts of the leaf blade and in older leaves on the lateral parts nearer the base. The color of the galls varies from greenish-white and pale yellow to dark cherry-red. The color depends on the species of aphis, on the species and variety of apple and on the location of the gall on the tree with relation to the sun. So, in D. flava Shap. and to lesser degree in D. zini Shap., pale yellow galls predominate; in other species the galls are red. On apples, on which the bursting leaves are reddish, only intensely red galls are formed. Pale yellow galls are considerably more often met with in the shaded portions of a tree than on the illuminated portion of the crown. This picture is typical of all species of the subgenus feeding on apple. Nevertheless, beginning with the second generation, substantial differences in the biology of the various forms were observed.

The life history of the autoecious species devecta has been quite well studied in Holland (Hille Ris Lambers, 1945) and in USSR (Shaposhnikov, 1950; Smirnova, 1951; Savzdarg, 1955). The fundatrix is followed by a

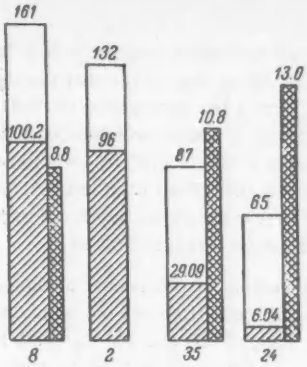

Fig. 3. Fertility of fundatrices bred in 1956 on apples under various conditions. Fertility is given as an over-all figure for three forms – a. anthrisci, a. chaerophyllina and, in part, radicicola, since no differences in fertility were observed in these forms. Upper figures show the maximum fertility; middle figures the averages and lower figures the number of breeding fundatrices; figures above the double-hatched column is the percentage concentration of sap observed in most of the young leaves May 6th 1956. 8) Young saplings of Malus orientalis with shoots still growing and provided with plenty of moisture; 2) adult trees of Malus orientalis with growing shoots; 35) old trees of M. domestica with intensively developing shoots which are finishing growth comparatively quickly; 24) young trees of M. domestica with weakly developing shoots which are very quickly finishing growth.

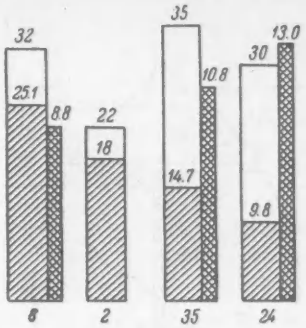

Fig. 4. Length of life of fundatrices bred in 1956 on apples under various conditions. Upper figures show maximun length of life; middle figures – the average. Remaining symbols as in Fig. 3.

generation of fundatrigenia, then by a generation of sexupare – apterous androparae and apterous and winged gynoparae, and finally by a double-sexed generation; the cycle ends at the beginning of summer by the laying of eggs which remain in the summer-winter diapause until the spring of the following year.

The migration of heteroecious species was orignially established by Börner (1952) in three species: radicicola, a. anthrisci and chaerophylli. Subsequently, the author determined experimentally the migration of these lines to secondary hosts in a. bunii Shap. (1953) and a. chaerophyllina (1954-1957), and the fact of migration in flava (1950) and zini (1953), and also migration in the species with which Börner had dealt were also verified (Shaposhnikov, 1950, 1956).

According to the observations of the author of these lines only winged fundatrigenia migrants are, as a rule, developed in the second generation of heteroecious species. In radicicola and in a. anthrisci solitary apterous individuals rarely occur but their progeny become migrants with, still more rarely, a few apterous individuals. Nevertheless, in a. chaerophyllina, particularly in mountainous districts, apterous insects in the 2nd generation are not so rare and sometimes they make up to 10% and even 30% of all individuals. They give rise to both migrants and apterous insects of the third generation. On apple shoots (in isolated conditions) we succeeded in tracing up to five generations of apterous fundatrigenia of this form although under natural conditions this was never observed. Apterous insects in the 2nd generation were often found also in a. bunii, sometimes in orientalis Mordv., and rarely in zini and flava.

Migrants, both of the second as well as of the succeeding generations, are on the wing from the end of spring to the beginning of summer and fly to their secondary hosts. Each form migrates to a strictly determined species of plant: a. anthrisci to Anthriscus silvestris Hoff. and A. nemorosa MB., a. bunii to Bunium sp., a. chaerophyllum to Chaerophyllum maculatum Willd., chaerophylli to Ch. bulbosum L., Ch. temulum and Ch. aromaticum L., radicicola to Rumex crispus L., and R. conglomeratus Mur. Although up to now their secondary hosts have not been determined orientalis, flava and zini also migrate.

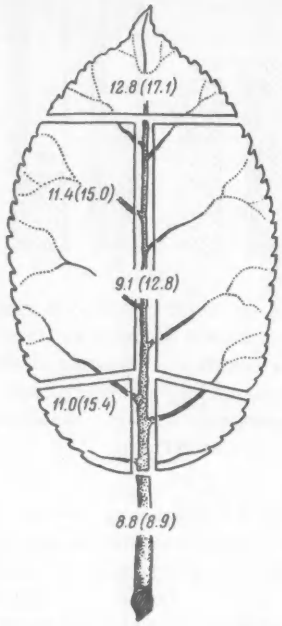

Fig. 5. Percentage concentration of sap in different parts of adult (figures in brackets) and young apple leaves, May 6, 1956.

On the secondary hosts the aphids form colonies on the basal stems, the leaves near the root and on the the root. Here a few generations of fundatrigenia are developed which, under favorable conditions, give rise to an average of 50-70 nymphs. Winged colonizers appear among them from time to time. As a result of the aphis attacks the plants become deformed. The aphids are always attended by ants.

The number of generations produced depends upon climatic conditions and on the nature of the secondary host. Thus, one and the same form of aphis a. anthrisci in Leningrad in 1950 on Anthriscus silvestris Hoff. gave seven generations during the season, but in N. Caucasus on A. nemorosa MB. in 1954, 1955 and 1956 it gave 14-17 generations. On the other hand, under similar laboratory conditions in Shuntuk in 1955, during the period from May 18-19 to November 8-11, on perennial plants the following results were obtained: 19 generations on Anthriscus, 18 on Rumex, and 17 on Chaerophyllum maculatum Willd. on which the life of the aphid colony was still unfinished. At the same time, on the annual Chaerophyllum bulbosum L. in connection with the natural withering of the plant, the Aphis cycle is terminated at the end of July under laboratory conditions at the 7-8th generation, but under natural conditions not until the middle of August.

In autumn (in N. Caucasus from the end of September to the beginning of November) winged sexuaparae appear and (from the middle of October to the beginning of November) winged males also. The remigrants fly to the apple where they give rise to nymphs of normal apterous females.

In connection with the cessation of growth in Chaerophyllum bulbosum L. in N. Caucasus the remigrants of chaerophylli were observed, not in the spring, but in the summer of 1957, from the middle of July to the middle of August.

After copulation the normal females lay from 1-6, generally 4, winter eggs and the life history finishes. On the apple, eggs are laid under bark scales on the trunk and on small branches: In nature this was observed in the autoecious species devecta (Hille Ris Lambers, 1945) and, evidently, takes place in heteroecious species also. Thus, repeated observations by the author on pure lines in a. anthrisci, a. chaerophyllina and radicicola on pot cultures of apples under isolators showed that the females, after fertilization, climb down the stem and freely oviposit only beneath objects, squeezing the eggs like bark scales, for instance, under sticky, paper bands.

The complete autoecious cycle on the secondary host is known for D. hirsutissima CB (Stroyan, 1950; Börner, 1952). According to the authors's observations in Leningrad eggs overwinter in the soil on fragments of Anthriscus silvestris Hoff. In spring these give rise to fundatrices which appear at the same time as the young growth of the host plants (young and adult fundatrices were observed on May 21, 1948 in Leningrad and once they produced quite numerous colonies). During the course of the summer a series of generations of apterous, and very rarely, winged fundatrigenia was developed but in autumn apterous males and normal females appear. Copulation and oviposition were observed in the Voronezh district on October 20 and 22, 1958; in the Leningrad district oviposition had ended by November 26, 1957.

Thus, among aphids of the subgenus Dysaphis CB. s. str. certain types of life history were studied: (1) an abbreviated autoecious life cycle on the primary host in devecta, (2) a normal heteroecious cycle in a. anthrisci. a. chaerophyllina and radicicola, (3) an abbreviated heteroecious cycle in the N. Caucasian chaerophylli and, evidently, in a bunii, (4) a complete autoecious cycle on the secondary host in hirsutissima).

TABLE 2

Diapausing or migrating	In what numbers	In which generation	Dependence on living conditions	Periphyllus Hoev. diapausing on Aceraceae	Dysaphis CB migrating to Pomoideae
Not any	–	–	–	P. lyropictus Kessl., P. viridulus Mam.	D. affinis Mordv., D. reaumuri Mordv.
Facultatively	A small number of individuals	In an indeterminate generation	Complete	R. granulatus Koch	D. sorbi Kalt.
Facultatively	The majority of individuals	Partly or predominantly in a definite generation	Considerable	P. minutus Shap., P. testudinatus Thornt.	D. pyri B. d. F.
Obligatory	All individuals	Predominantly in a definite generation	Weak	P. californiensis Shinji., P. negundinis Thom.	D. mali Ferr., D. aucupariae Buckt.
Obligatory	All individuals	In a definite generation	Absent or insignificant	P. acericola Walk., P. aceris L.	D. anthrisci CB, D. ranunculi Kalt. and many others

Life Conditions of Aphids on Their Primary and Secondary Hosts

In the elucidation of the causes for the interchange of hosts, for understanding the phenomena of heteroecy, of summer-winter diapause and other features in the life histories of aphids, comparative studies of their conditions of life can be of much assistance. Besides, the physiological state of the host plant, which was emphasized earlier, exercises an enormous influence (Mordvilko, 1901; Kennedy, 1953).

In the first place it is important to analyze the life conditions of aphids on their primary host at the end of spring, during the period when the most abrupt changes occur in their life cycles.

In apple leaves at the end of spring, important physicochemical changes take place, changes which are dependent upon the ripening and slowing down of the growth of the shoots. The soluble nitrogen content, both absolutely and especially in relation to protein nitrogen, sharply diminishes, the amount of sugars becomes less, the ash content * rises, the water content is reduced (Shaposhnikov and Eliseev, 1959) and catalase activity diminished (Savzdarg, 1955). In addition, the concentration of cell sap rises and with it its osmotic pressure. The viscosity of the sap, evidently, changes also. As Sokolov and Sokolova (1952) have shown, the osmotic pressure of apple leaves depends, not only on the seasonal physiological condition of tree development but also on the humidity of the air and the soil and the quantity of contained solids; a rise in the osmotic pressure to 10 atmospheres renders apple leaves unfit for the Aphis pomi Deg. As is seen in Table 1 and in the graphs (Figs. 1 and 2) the concentration of sap in leaf tissue rises from May to August, reflecting to a large extent the fluctuations of relative humidity and temperature of the air. A very abrupt rise in the concentration of sap is noticed in the short period of 20 days in May, between spring and summer.

The rise in osmotic concentration in cells shifts the fermentation reaction in the direction of synthesis (Sisakyan and Kobyakova, 1944), which partly contributes to the lowering of the soluble nitrogen in relation to the total nitrogen. The increase of synthesis and the lessening of hydrolysis is shown by the resistance of the grape vine to phylloxera (Zotov, 1955).

There is reason to suppose that these changes cause a deterioration in the conditions of the aphid's life or, at any rate, they appear to be indicative of such a deterioration. At all events the fertility and

* The ash contains microelements, certain of which can exert a negative influence on aphids, for example, the watering of cotton plants with a solution of copper, borax and manganese led to a sudden reduction in the numbers of aphids (Mamedova, 1957).

average length of life of fundatrices, in the nymphal adult phase, transferred at the end of April, 1956 from their galls to other trees, depended to a large extent on the rate of growth of the shoots and leaves and was strictly correlated with the concentration of leaf sap (Figs. 3 and 4).

Both in nature and under experimental conditions it was noticed that fundatrices, as well as aphids of the succeeding generations, could produce galls only on the youngest leaves. On leaves which were not very young only semblances of galls are formed,but on older leaves none are produced. At the same time fundatrices make galls at the apex of leaves which are just opening but the following generation, as a rule, produces them on the lateral parts of the leaf blade and, on more mature leaves, on the sides near the base. A similar picture is seen in devecta (Savzdarg, 1955) and also in other aphids, for example, in the vine phylloxera (Kostik, 1955). It is characteristic that aphids breeding on shoots which are ceasing their growth or on well-growing shoots, in summer, preferred the base of the central vein, the petiole of the leaf or the cortex in the upper part of the growing shoot, that is, the aphids produced galls and generally fed at places where the concentration of sap was lower (Fig. 5.).

In galls, compared with undamaged leaves of the same stage and growing on the same shoot, the concentration of sap remains lower during the whole period of leaf growth. In galls there is a considerably higher content of soluble nitrogen and water (Shaposhnikov and Eliseev, 1959), a higher catalase activity and intensive transpiration (Savzdarg, 1955). Nevertheless, the concentration of sap in galls (according to other indications not given) is changed in the same direction as in corresponding undamaged leaves (Table 1 and Figs. 1 and 2). Besides, on young leaves and in the absence of galls, the fundatrices and aphids of the succeeding generations can normally propagate themselves for a long time and preserve a fairly high fertility. Hence, one may conclude that by gall formation the aphids under investigation improve the conditions favorable to them and, as it were, extend them,but only for a few days.

It is worth noticing that, in galls produced by the aphid species in question, the aphids sometimes feed and multiply together with aphids of another group for example, Rhopalosiphon insertum Walk., Aphis pomi Deg. In precisely the same way the damaged or abandoned galls of Pemphigus Hart. on poplar are frequently colonized by representatives of the genus Chaitophorus Koch and so forth, Aphis steinbergi Shap. (=commensalis Stroy) lives in the galls of the plant lice (Psyllidae) on buckthorn (Stroyan, 1952), Brachyunguis saxaulica Nevs. is well known on haloxylon, and there are other instances (Profft, 1937). These facts demonstrate the well-known universality of galls as food which, nevertheless, does not deprive them of their great specificity in other relationships.

The environment in which aphids live has an important influence on them due, probably to a great extent, to the physiological changes taking place in the host's condition. Sabzdarg (1955) observed devecta on trees of the same kind and age but grown under various conditions of elevation and plant density: in plots situated at a low level where the trees grew more densely and were shaded,the aphids multiplied much quicker than on plots situated on hills with the trees more sparsely planted and where leaf-aging proceeded faster. A number of similar factors is well known (Shaposhnikov, 1956:299)

At the beginning of summer a general ripening of the leaves and a cessation of shoot growth are observed. In the autoecious devecta during this period sexuaparae appear and subsequently, males and normal females, and then the life history is terminated by the laying of diapausing eggs at the beginning of summer, and not in autumn as is usual.

In the heteroecious aphids migration ends at this period. But those aphids which, for some reason or other, lagged behind develop slowly. These observations are confirmed by the results of special experiments. Thus, on May 26, 1955, when the majority of indigenous aphids had already flown from the apple old but still capable of reproducing, fundatrices of a. chaerophyllina from more mountainous regions (Khadzhokh) were isolated, one by one, onto young shoots of Malus orientalis in the forest. In the majority of instances their descendants, although developing slowly, changed into normal migrants. The last of these migrants were on the wing June 15, while the local individuals were not seen later than June 4. It is remarkable that descendants of similar fundatrices, bred on young trees of M. orientalis under conditions of high humidity in the laboratory, developed considerably more quickly than on trees in the garden. Fundatrices brought from other mountainous regions (Sakhrai) on May 31, that is, only just five days earlier, also gave rise to a small number of nymphs but the latter developed extremely slowly and all died in one or other stage, never reaching the imago.

Still, more or less natural conditions for development of the aphids under investigation, at least in favorable years, are maintained on the apple probably throughout the whole summer. Thus, during the abundant rains

of 1956 we succeeded in rearing apterous fundatrigenia of a. chaerophyllina for a long time in the laboratory and in the field under-isolators on infrequently met with young shoots, on artificially produced thistles but principally on scrub. In the course of two months, after the last migrants dispersed, five generations of apterous fundatrigenia and migrants were produced while during the arid conditions of 1957 we succeeded in rearing only two generations. However, it is necessary to notice here that the fertility of the apterous fundatrigenia in 1956 gradually diminished from generation to generation and dropped from 50 nymphs in the second generation to 2-15 in the fifth and sixth. Mortality among the nymphs was not noticed in the second generation whereas in the fifth and sixth it was from 45% to 100%. Hense, the number of surviving descendants in unit time diminished some hundred times.

Beketov (1860) formulated a general law: "The more that living creatures are given the facilities to increase the more readily they are subject to exterimination". Similar ideas were expressed by Lamarch (published 1935: 88). Aphids appear to corroborate the action of this law very clearly. In general they are poorly equipped for defense and, basically, their armament in the struggle for existence appears to be their high rate of multiplication.

Although the conditions for development of a. chaerophyllina in summer on apples maintained, for example, on scrub and thistles in wet years, the chances for the survival of the species under these conditions are very small. The low vitality of aphids under natural conditions cannot guarantee a sufficiently high rate of increase to maintain the number necessary for the preservation of the species in the struggle with chemicals, parasites, diseases and other unfavorable environmental factors.

The fact that the majority of aphids prefer young, growing parts of plants or, inversely, aging leaves,— for many species are not at all able to develop on adult leaves — was well known long ago by all who observed aphids under natural conditions and it is verified by special examples (Kennedy and Booth, 1951; Bonnemaison, 1951). The cessation of the growth of shoots was considered as one of the reasons (Mordvilko, 1901) or, at the present time as the sole cause, of the migration of aphids (Popova, 1950).

Nevertheless, this question is more complicated than is seen at the first glance. Firstly, the heteroecious species, as will be shown below and as was noticed earlier (Swirski, 1954), often migrate from growing leaves which are quite suitable for feeding. Secondly, actively growing young leaves are not always suitable for normal development and multiplication of aphids. Thus, the summer generation of a. chaerophyllina, being bred on the tips of well-growing apple shoots having a daily growth increment of 8-15mm, as already noticed, developed extremely slowly and the fertility and survival dropped abruptly. It is possible that one cause for this fact was the high concentration of sap in the shoots and leaves (16.6-17.4%) on which the aphids fed while in spring it was 7.1-14% in aging leaves and the content of nonprotein nitrogen was low. Viale (1950) was unsuccessful in maintaining colonies of Rhopalosiphon maidis Fitch. on young corn only a few weeks old whereas, an older plants, the aphis developed and multiplied normally. A similar picture was seen in the aphis Hyalopterus arundinis F. on reeds (Swirski, 1954). Thirdly, our investigations, carried out together with F.D. Sapozhnikov, showed that various individuals of one or other species of aphis possess different adaptations to feeding conditions. Thus, the apterous fundatrigenia of Brachycaudus divaricatae Shap. and their progeny can develop exclusively on young plum leaves, whereas at the very same times during the summer sexuaparae were capable of normal increase, but their descendants developed normally also on adult leaves and in nature even preferred them. The same can be said about the autumn sexuaparae which feed on young as well as adult and aging leaves and generally prefer them young. Adaptation to feeding on leaves of a definite age is natural in other groups of insects (Kozhanchikov, 1947,1949; Fromming, 1955), and also in acarines (Shevchenko, 1959).

The graphs (Figs. 1 and 2) and the data from biological analysis (Shaposhnikov and Eliseev, 1959) show that in the tissues of herbaceous plants — the secondary hosts of the aphid species in question — the concentration of sap, the water content and the relation of soluble nitrogen to protein nitrogen throughout the season approach those in apple leaves during the spring period. From that, one can surmise that on their secondary hosts the conditions of life for aphids remain as favorable as in the spring conditions on the apple. This is confirmed not only by the high vitality of aphids on their secondary hosts but by certain experiments. Third and fourth stage pronymphs and nymphs of a. anthrisci, originating from one and the same fundatrix, were bred simultaneously in their leaf galls on apple and on Anthriscus to which they were transferred on June 26, 1956. On Anthriscus the aphids developed as well as they did on apple, developing into apterous fundatrigenia and winged migrants and multiplying normally.

In Shuntul in June-August the aerial portions of Rumex, Anthriscus and Chaerophyllum maculatum whither, and the aphids during that period migrate or are carried by ants on to the roots or the emerging root shoot of these plants. Consequently, the development of the aphids on the secondary hosts proceeds normally throughout the summer until well into the autumn.

A study of the biology of the plum aphis (Brachycaudus divaricata Shap.) carried out in Shuntuk in 1956, together with F.A. Sapozhnikov, showed that the interrelation between favorable and unfavorable environmental conditions on the primary (Prunus divaricata) and on the secondary host (Melandrium album) was always similar to that on the primary and secondary hosts of aphids of the subgenus Dysaphis. The favorable conditions are exactly the same as those characterizing the large water supply to the plant tissue and, in particular, by the high content of water-soluble nitrogen, both absolutely and in relation to protein nitrogen. In addition, it is interesting to notice that a water content of approximately 70% and a relationship of water-soluble nitrogen to protein nitrogen of about 0,1 specify certain limits below the conditions of life for the spring-summer forms of aphid remain unfavorable both for the species of the subgenus Dysaphis and for Brachycaudus divaricatae Shap.

Lastly, a simple comparison of the given biochemical analyses of plants with the behavior of the aphids living upon them is, to some degree, untrustworthy. Nevertheless conclusions based upon such a comparison can show the way for special, considerably more exact, ecological-physiological investigations. Besides that, these relationships can serve, to a large extent, as pointers to the adaptability of plants, or parts of them, for aphid feeding.

That the amount of nitrogen in plant sap or in the soil, particularly its soluble form, was of real importance to the development and increase of aphids was seen from the results of a series of investigations (Pantanelli, 1909; Lees, 1926; Schafer, 1928; Evans, 1938; McGarr, 1942; 1943; Isely, 1946; Haseman, 1947; Auclair and Maltais, 1950; Maltais, 1951; Bobinskaya, 1953; Zotov, 1955; Maltais and Auclair, 1957; Mittler, 1958). In the same way many research workers have shown the importance to aphids of the water content of plant tissue.

With regard to partial liberation from natural enemies certain investigators reckon that migration to secondary hosts is desirable. According to observations in Shuntuk and in other places, aphids of the subgenus Dysaphus suffer from predators and parasites less on secondary hosts than on apple. On herbaceous plants aphids are better attended by ants.

As is seen in Fig. 1 the concentration of sap in apple leaves is higher in autumn than in spring, or even at the beginning of summer, and is considerably higher than in the stems and roots of herbaceous plants in autumn. The water content and proportion of soluble nitrogen to protein nitrogen in apple leaves in autumn is lower than in herbaceous plants. Consequently, one must surmise that the life conditions for aphids on their secondary hosts in autumn are not deteriorating and, in all cases, they are better than on apples at the same time of the year (Shaposhnikov and Eliseev, 1959). The following straightforward observation is relevant in considering the suitability of secondary hosts in autumn: Aphids feeding on them reproduce normally until the end of the season. Thus, even on November 2, 1955, when the majority of apples had already lost their leaves, large colonies of aphids containing many apterous fundatrigenia were found on Rumex and Anthriscus in the field; on November 1, 1957 a. anthrisci was colonizing 31% of the plants found and the colonies consisted of 11% (60 out of 535) apterous insects; a. chaerophyllina colonized 1% of the plants and the apterous individuals comprised 7,8% (3 out of 38). In the laboratory by this time they had passed through the 19th generation on Rumex and the 20th generation on Anthriscus. Under laboratory conditions apterous fundatrigenia multiplied on secondary hosts throughout the whole year.

It is different with chaerophylli on Chaerophyllum bulbosum L. In Shuntuk this annual stops growing in July-August and by the middle of August the last living plant disappears. Because of this the aphids produce only 7-10 generations and they remigrate in July-August. It is of interest to note that aphids develop even on half-dried host plants in which a high content of nonprotein nitrogen in relation to protein nitrogen is maintained and in which the water content is low (57%).

In this way the life history studies of aphids of the subgenus Dysaphis CB. coupled with a simultaneous analysis of their life conditions on primary and secondary hosts, have led to the following conclusions:

(1) In summer the conditions of life for aphids on their primary host are so unfavorable that the aphids are unable to secure a survival of the species.

(2) The migration of heteroecious species and, at the same time, the appearance of "autumn" forms preceding diapause in the autoecious forms takes place immediately before the period when conditions on their primary host become unfavorable.

(3) Life conditions for aphids on secondary hosts are close to spring conditions of life on apples and, in the majority of instances, are favorable throughout the year.

(4) The remigration of heteroecious species and, similarly, the appearance of a bisexual generation in autoecious species living on secondary hosts, takes place at a period when conditions on secondary hosts are not deteriorating and, in all cases, are better than those on the primary hosts.

(5) Nevertheless, on some secondary hosts which terminate their growth early aphids cannot support themselves and at this period remigrants are produced.

Causes of Migration and Diapause in Aphids

In 1955,1956 and 1957 a few thousand migrants were bred under isolators. Many of them were not used in experiments and died a few days after emergence. The migrants did not feed or increase and finally died, notwithstanding the fact that their young sisters, the future migrants, developed normally and the apterous sisters and the fundatrices multiplied normally in the same galls for a number of days after the death of the migrants. Exceptions occurred when on the rarest occasions individual nymphs of a. chaerophyllina, in the 3rd and 4th generations on young apple leaves, produced form 1-3 nymphs which subsequently died in the 1st and 2nd stages.

It follows that the migrants of the species in question represent an individual specialized form incapable of feeding or multiplying on the primary host under any conditions.

Such a form could develop only during the formative process of the heteroecious cycle. Comparing the life histories of representatives of Aphidinae living at the present time it is possible to indicate the following stages in this process:

(1) Winged forms, together with a large number of apterous forms, appear during the period when life conditions on woody plants are deteriorating; they play the part of colonizers on other parts or other individuals of the same host; this autoecious cycle is the only mode of life; for example, Aphis pomi Deg. (Popova, 1950) and other species.

(2) Winged forms, together with a large number of apterous forms, appear during the period when life conditions on woody plants are deteriorating; they act both as colonists on other parts of the same host, and as migrants spreading to herbaceous plants; the autoecious cycle evidently plays a more important part than the heteroecious cycle; for example, Myzus cerasi F. (Dobrovlyanskii, 1915) and a few other species.

(3) Winged forms, together with a large number of apterous forms appear both during the period when conditions of life on woody plants are deteriorating and before that period; they play the role of migrants and are incapable of reproducing themselves in any way properly on the primary host; both autoecious and heteroecious cycles play an important part in the life of the species; for example: Brachycaudus divaricatae Shap. (the author and F.D. Sapozhnikov) and other species.

(4) Migrants incapable of feeding and multiplying on the primary host appear together with a small number of apterous forms, principally before the onset of the period when conditions are becoming worse; the percentage of migrants grows from generation to generation and they are gradually replaced by apterous individuals; the heteroecious cycle has an exclusive significance whereas the autoecious cycle appears as an appendage to it, a biological relic; for example: Dysaphis piri B.d.F. (Savory, 1953) and other species.

(5) Migrants incapable of feeding and reproducing on the primary host appear predominantly before the onset of the period when living conditions are deteriorating and all, or almost all, the insects of the second generation are winged; the heteroecious cycle is the sole way of life; rarely appearing fundatrigenia represent its biological relic; for example, Dysaphis radicicola Mordv. (the author) and many other species.

These examples are sufficient to show how gradually the substitution of colonists by migrants is accomplished, how the autoecious cycle is replaced by the heteroecious, how migration during the period of deterioration of life conditions is changed for migration before the onset of this period.

It is obvious that, in the early stages of the formation of heteroecy, the appearance of migrants is stimulated by the deterioration of feeding conditions on the primary host. But gradually external stimuli, whatever they were, superceded by a more complex mechanism: fundatrices specialized in producing only migrants.

To some extent this process had already begun in the autoecious species. Thus, among many of them winged colonizers appear, often in considerable numbers and timed to the 2nd or 3rd generation. It is worth noting that in the same Aphis pomi Deg. (Baker and Turner, 1916) only the winged individuals of the 2nd generation migrate.

Judging from the fact that in a. chaerophillina and a. bunii the presence of apterous forms in the second generation is a common occurrence and in a. anthrisci a more rare event, one can conclude that even very closely related forms proceed somewhat differently in the formation of the obligate-heteroecious cycle.

Thus, we must reckon that the chief cause of migration in modern times in the species of aphid under investigation is the acquisition by inheritance of the capacity of the fundatrices to produce, under any conditions, migrants exclusively or predominantly. This enables the aphids to leave unfavorable environmental conditions early before their onset.

At the same time a comparison of the conditions of the life of aphids on their primary and secondary hosts during different parts of the season, and the comparison of the life histories of the various species of aphid of the subfamily Aphidinae, compels one to consider that the cause of the migration of aphids onto herbaceous plants in past times was the deterioration of life conditions on the woody hosts.

Therefore, in the migration of aphids one should examine historically how adaptation to survival over the unfavorable summer period has been perfected.

In aphids of the genus Periphyllus Hoev. (Chaitophorinae) the nymphal diapause serves as an adaptation to surival over the unfavorable summer period.

In the facultative diapausing species diapause is often brought about by a deterioration of conditions as with migration in certain facultative heteroecious species. Thus, the 1st stage nymphs of Periphyllus testudinatus Thorn. diapause on adult but not on young leaves of brushwood (Hille Ris Lambers, 1947). It is exactly the same with the 1st stage nymphs of the phylloxera (Viteus vitifolii Fitch) which diapause so long as the roots of the vine contain less than 60% water (Larchchenko, 1949).

In the obligatory diapausing species of Periphyllus Hoev. the direct influence of unfavorable feeding conditions is gradually replaced by the capacity of apterous and winged fundatrigenia, of strictly determined (second) generation, to produce diapausing nymphs exclusively, independently of external conditions.

One should examine in exactly the same way the obligate summer-winter diapause of aphids with an abbreviated life history, particularly in devecta. Here also the influence of the deterioration of conditions is replaced by a fixed number of generations, for example, in devecta all the individuals of the 4th generation, in Aphis farinosa Gmel. of the 3rd, and in Acanthochermes quercus Kollar. of the 2nd generation, appear as normal males and females, but the eggs laid by the females diapause until the spring of the following year. The summer-winter diapause in the 1st instar nymph was observed in the chermes (Adelginae) and in the imaginal phase of Hamamelistes spinosus Shim. (Shaposhnikov, 1956b).

From the following comparison (Table 2) it is possible, to a certain extent, to see the remarkably similar stages in the production of heteroecious and diapausing species of aphids.

In this way, the evolution of both heteroecious and diapausing species of aphid led, all things considered, to a strictly fixed number of autumn generations which predetermine migration usually in the 2nd, the summer diapause in the 3rd, and the summer-winter diapause in the 3rd-5th generations, and is independent, or almost independent, of external conditions.

This phenomenon is quite similar to that observed among certain butterflies, for example in Acronycta rumicis L. In contrast to the southern races in which winter diapause and the number of generations are determined by a photoperiodic reaction, diapause in the notheren races is less dependent upon external factors and is, to a considerable degree, predetermined by a hereditary periodicity (Danilevskii, 1957).

Phenomena, similar to diapause, are observed in Drepanosiphum platanoides Koch, on maple leaves where the adult fundatrigenia are able to live for a long time in summer without multiplying (Mordvilko, 1901:113, 869), and in Pemphigus spirothecae Pass. in galls on the petioles of poplar leaves where, in summer, the development of the aphids of the 2nd generation is long delayed.

As one of the adaptations to survival during the unfavorable summer period on woody plants, and also on certain herbaceous plants, the separate forms of summer, apterous fundatrigenia should also be examined. These

are characterized by a shortened body, contracted limbs, lower number of antennal segments (5 instead of 6), reduced fertility and a capacity for living in less favorable conditions, especially in the presence of moisture deficiency. Such forms are observed in members of the genus Aphis L. (A. gossypii Glov., A. idaei Goot., A. ruborum CB and others) in Semiaphis nolitangere Aiz. and Hayhurstia tataricae Aiz. (Aizenberg, 1956).

Among certain species adaptation to unfavorable summer conditions is accomplished simultaneously in two directions, wherefore their life histories are made up of two parallel series. For example, in Brachycaudus divaricatae Shap., in one and the same clone, summer-winter diapause and heteroecy are observed, and in Aphis idaei Goot. the formation of a separate summer form of apterous fundatrigenia and migration to other parts or individuals of the host.

Causes of Remigration and Cessation of Summer Diapause in Aphids

Remigration of northern Caucasian populations of chaerophylli, as shown by special investigations, is connected with the deterioration of feeding conditions on moribund annuals. Evidently, it is the same in other aphids with an abbreviated, heteroecious cycle (Shaposhnikov, 1959b).

A.K. Mordvilko (1901,1935), observing aphids many times in the field, came to the same conclusion long ago and extended it to all aphids. Kennedy and Booth (1954), in making experiments with Aphis fabae Scop., also correlated remigration with food: Aphids leave their primary hosts when the leaves are unsuitable for feeding and return in autumn to aging leaves which are fit for food.

For a number of species it is demonstrated that the appearance of remigrants in the heteroecious cycle and, similarly, of the amphigonous generation in the autoecious cycle, is stimulated by the diminishing length of day combined with the reduction in temperature (Marcovitch, 1924; Shull, 1930; Wilson, 1938; Bonnemaison, 1951). There is every reason to suppose that such a sequence of stimuli is peculiar to the majority of aphid species living on the ground and having a normal heteroecious or autoecious cycle.

Inasmuch as the data and conclusions brought forward in each concrete case do not relieve us of doubts, we are obliged to state that the present causes (stimuli) for the appearance of remigrants are different in the different species and subspecies. Moreover, they can be different in different populations. Thus, a northern Caucasian population of chaerophylli remigrates in the middle of summer during the period of deteriorating feeding conditions on the dying annual Chaerophyllum bulbosum L. whereas the population remigrates in autumn from the perennial Ch. aromaticum L. which, evidently is still suitable for feeding (data from L.M. Gusyninoi).

It is possible to explain the observed diversity of the present causes for remigration as a twofold character.

On the one hand, the appearance of remigrants is nothing less than the appearance of the amphigonous generation (males) and the generation (sexuaparae, gynoparae) preceding it. Therefore, it is natural to suppose that in the heteroecious forms fundamentally the same reactions and the same stimuli are preserved, those which ensured the timely appearance of the amphigonous generation in their autoecious ancestors, namely, the capacity to produce sexuaparae and males under the influence of definite external factors, above all, the combination of a short day with diminishing temperature. The autumnal appearance of the amphigonous generation guarantees the winter diapause (in the egg stage). Altogether one should consider it as the capacity to survive the cold winter period (a primary periodic factor, according to the classification of Monchadski, 1958).

On the other hand, in connection with the special features of aphid life on secondary hosts, the substitution of old, unsuitable stimuli by new ones arises. For example, in underground forms photoperiodic reactions are replaced by some other stimuli, possibly by reactions to delicate changes in the composition of the food or even by "time factors" (Wilson, 1938) or by "external factors" (Bonnemaison, 1951). It is exactly the same in species with an abbreviated heteroecious cycle; the reactions to temperature and long photoperiod is substituted by the direct influence of the deteriorating conditions of feeding (secondary periodic factor).

Such are the modern causes for the appearance of remigrants. Historically, one ought to consider this remigration as the inevitable result of migration to a new host of such specialized species of aphids in which the whole life history cannot take place on the new host, for example, fundatrices cannot normally develop (Mordvilko, 1925,1935; Shaposhnikov, 1955,1956).

Therefore, it is quite clear why anthrisci, radicicola and, one must suppose, many other species, fly from

secondary hosts at a time when living conditions on them are not deteriorating and are, at least, better than those on the primary host. Hence, the predominance in the sexuaparae of Aphis fabae Scop. of "aromatic" stimuli (the preference for a species of host) over "nutritive" (preference for quality of food) (Kennedy and Booth, 1954), that is, the sexuaparae certainly do not prefer that food which procures the highest fertility but the food of a definite plant species: Whether living conditions during autumn on the primary host are better or worse than those on the secondary host the aphids must return to them, otherwise their descendents are doomed to die. And, naturally, the earlier in its phylogeny that the species passes over to heteroecy the more the "aromatic" stimuli will predominate over the "nutritive" stimuli until they completely disappear in the remigrants (and likewise in the migrants) of obligatory, heteroecious species. In this biological device for autumnal migration of aphids the change is often from better to worse conditions.

As concerns the cause for the cessation of summer diapause, so in species of the genus Periphyllus Hoev. this is determined, apparently, in the basic photoperiodic reaction (Bonnemaison, 1956). However, in certain species diapause is suspended by some or other cause not yet determined (Hille Ris Lambers, 1947; Essig and Abernathy, 1952; Mamontova, 1955). In P. acericola Walk. diapause was successfully terminated by lowering the water content of maple leaves, but in P. aceris L. this action only caused the nymphs to creep to other places without coming out of diapause (Hille Ris Lambers, 1947).

Among the reasons for migration and remigration the factor of density among aphids was not mentioned. In spite of a series of researches (Samoilovich, 1950; Bonnemaison, 1951; Lal, 1952; Real, 1955; Pintera, 1957, 1958) the question of the influence of aphid density on the formation of the winged form up to now is not clear. It is indisputable that winged forms appear in exhausted as well as in dense colonies, but in the latter they appear in considerably larger numbers, and often in very dense colonies winged forms are nonexistent.

Observations on the aphid species under investigation, and similarly on many others, induces us to consider density, not as a factor causing the appearance of winged forms in general and of migrants and remigrants of obligatory heteroecious species in particular, but only as a factor influencing the quantitative aspect of the phenomenon, as a powerful booster of the production of winged forms. In many instances of such intensification it is possible to consider it as an adaptation disposing of the danger of over-population.

Heteroecy and the Total Migration of Aphids on to New Hosts

Dysaphis hirsutissima CB. living autoeciously on Anthriscus, is morphologically very close to anthrisci and chaerophylli, migrating from Malus to Anthriscus and Chaerophyllum, and also to other species of the subgenus Dysaphis, which, as is well known always live on apple as the primary or the only host. Thus, once can suppose with reasonable probability that hirsutissima migrates to Anthriscus only from the apple.

It is logical to presume that the cause of migration of this species is the same as that in its nearest heteroecious relatives: the deterioration of living conditions on the apple.

The question of why hirsutissima migrates completely to Anthriscus and the species near to it migrate only heteroeciously is satisfactorily explained by Mordvilko's hypothesis connecting the potentialities for migration with the degree of specialization of the fundatrices (Mordvilko, 1925, 1935; Shaposhnikov, 1956: 226).

Heteroecy, according to the ideas of Mordvilko (1901,1925,1935), Davidson, (1921,1927), and in particular Kennedy (1953; Kennedy and Booth, 1951,1954), gives aphids the opportunity of utilizing their feeding conditions to the best advantage: spring and summer on the primary host, summer on the secondary host, in consequence of which "gain in nutriment" was assumed at the beginning of the evolutionary cycle in the direction of heteroecy. But does heteroecy really give a gain in nutriment in comparison with autoecy on the secondary host on which feeding is favorable the whole season? And if there is a gain in nutriment, then is it large enough to cover the losses incurred by migration during which enormous numbers of migrants and remigrants die? These questions do not arise if we consider heteroecy as a special instance of change of host, as enforced phenomenon (Shaposhnikov, 1955), as an adaptation to unfavorable summer conditions on woody plants in those species which, for example, cannot migrate completely to secondary hosts because of the great specialization of the fundatrices (Mordvilko, 1925,1935; Shaposhnikov, 1955, 1956).

SUMMARY

1. Seasonal changes in the physiology of woody plants results in a profound deterioration, at the beginning of summer, of the life conditions of aphids on those plants, the numbers in many species being so reduced that they are incapable of surviving the summer.

This deterioration of conditions is indicated (or, possibly, caused) by the intensification of synthetic processes resulting, in the first place, in the reduction of the water-soluble nitrogen content of the leaves, especially of the water-soluble nitrogen – protein nitrogen ratio (below 0.1), by the decrease in water content of the tissues (below 70%), by the increase of sap concentration (up to 14% and higher) and by the osmotic pressure (up to 10 atmospheres or more) of the sap.

2. The unfavorable conditions of life on woody plants in summer compels the aphids to change their habits. Thus, various adaptations have been developed such as migration, change of hosts (particularly, alternation of hosts or heteroecy) retarded development and diapause.

3. By migrating to herbaceous plants the aphids again obtain those favorable conditions which, in summer, are lacking on woody plants, in particular, a higher water-soluble nitrogen – protein nitrogen ratio (over 0.1, not infrequently 0.2-0.5 or higher), a fairly large water content of tissues (over 70%, frequently over 90%) and lower concentrations of sap (below 14%, frequently 10%, 5% or lower).

4. In the course of the initiation and evolution of heteroecy and diapause, the primary stimulus (unfavorable food conditions) that had been causing these phenomena was gradually replaced by a more perfect mechanism: In obligate heteroecious and obligate diapausing species a firmly stabilized number of spring generations predetermines (irrespective of the environmental factors) the onset of migration, summer diapause and diapause extended from summer through autumn and winter, usually in the 2nd, 3rd and 3rd-5th generations respectively.

5. Remigration should be regarded as an inevitable sequel of the transition of aphids to new host plants. The appearance of the amphigonous generation and of that directly preceding it (including remigrants) is generally stimulated by the autumnal decrease in length of day combined with the lowering of temperature. This ancient reaction, inherited by heteroecious species from their monoecious ancestors, in some species has been secondarily replaced by responses to other stimuli.

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INTRASPECIFIC RELATIONS OF PREDACEOUS LARVAE. SUBFAMILY CHAOBORINAE (DIPTERA, CULICIDAE). I

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As is well known, there are two points of view on the character of intra- and interspecific relations and their role in species formation. According to one: between individuals of a species there exists a competitive relationship which may, under conditions of overpopulation, insufficient food, etc., attain a great acuteness and be a leading factor in the evolution of a species. At the same time the relations of external factors to a species, among their number interspecific relations, do not by themselves determine the specificities of the evolutionary process, but act only through intraspecific relations. According to the other point of view acutely competitive relations between individuals of one species are not only absent, but the individuals are mutually beneficial when co-habiting in a single association, when interspecific relations are of an acutely competitive nature. Intraspecific relations are not moving forces in the process of evolution of a species. It is determined by external factors, among their number interspecific relations. Between these extreme points of view there is a variety of expositions.

For plants, among the quantity of evidence for a settled point of view, there were often special experiments and observations arranged and debates conducted on the degree of their reliability and validity, whereas in relation to animals special practical experiments were absent and arguments for and against were founded on biological observations, often inspired without sufficiently critical treatment.

Both sides of the debate were, however, similar in one respect: the fact was overlooked that intra- and interspecific relations, like all biological phenomena, cannot remain static but must change in the process of a species' evolution in the course of its adaptation to the surrounding conditions of existence. Such an anti-historic approach, expressed on any simple question raised on the character of intra-and interspecies relations, afflicted to the same degree the defenders of both the extreme points of view.

I have been interested for a long time in the question of adaptive evolution in the culicid family, especially the larvae in which the variety of adaptations to their surrounding meduim is indeed inexhaustable (Monchadskii, 1936, 1937). Particularly interesting in this respect are predaceous larvae. Investigations of the biology and behavior of the larvae, and functional analysis of their adaptation to movement, feeding, breathing, in different specific conditions of their habitation have led me to the conviction that they are suitable subjects for experimental studies of intra- and interspecific relations between them.

For our conditions the most convenient for this were larvae of the subfamily Chaoborinae. In the taiga zone there are encountered, often together in the same pond, representatives of three closely related genera of this subfamily: the genus Cryophila with one species (Monchadskii, 1939), the genus Mochlonyx with one species having two seasonal variations (Monchadskii, 1953) and the genus Chaoborus with five species. Cryophila has 1 generation in which the larvae hatch in the spring from overwintered eggs, and development is completed in a rather contracted period. Mochlonyx has 2 generations: a spring generation from overwintered eggs and a summer generation. Chaoborus has 2 summer generations and 1 wintering in the larval stage. Thus spring and the beginning of summer are the only periods during the year when larvae of all three species are encountered in nature, often together. From the middle of summer and to the beginning of autumn can be found

summer-generation Mochlonyx larvae and larvae of Chaoborus, and in late autumn and winter only the latter are encountered in the ponds.

All the larvae in the subfamily Chaoborinae are active predators, and with few exceptions lead a pelagic life and have cuticular respiration. Observations showed that they feed on crustaceans and insect larvae swimming in the depths of the water or at its surface. During this they may also catch and eat members of their own species, and larvae of other species of Chaoborinae.

The work was conducted in the Prague region of Karelian ASSR during the spring and beginning of summer in 1958. Choice of location was determined by large abundance of Cryophila larvae, which are rare in the southern parts of the taiga zone. Supplementary experiments with larvae of the summer generation of Mochlonyx and Chaoborus were conducted in the second half of summer and autumn in Leningrad.

TABLE 1

Tests on the Collective Maintenance of Larvae of Cryophila lapponica

Total Nos.		Stage and size of larvae	Date at beginning of tests	Remaing alive to the end of the test				Devoured			Dead from other causes			Duration of tests (in days)	
					of them				of them			of them			
tests	larvae			total	larvae	pupae	adults	total	larvae	pupae	total	larvae	pupae	range	mean
Without food															
6	55	$L_{II \to III}$	23 V	6	6	0	0	49	49	0	0	—	—	5—6	5.8
12	100	$L_{III \to IV}$	28—30 V	26	6	14	6	52	52	0	22	9	13	8—15	7.8
With feeding on larvae of Aëdes in corresponding stages															
6	55	$L_{II \to III}$	23 V	6	6	0	0	49	49	0	0	—	—	5—8	6.1
10	100	$L_{III \to IV}$	28—30 V	46	3	29	14	47	46	1	7	3	4	7—13	10.1

TABLE 2

Tests on the Collective Maintenance of Larvae of Cryophila lapponica

Total Nos.		Stage and size of larvae	Date at beginning of tests	Remaining alive to the end of the tests				Devoured			Dead from other causes			Duration of tests (in days)	
					of them				of them			of them			
tests	larvae			total	larvae	pupae	adults	total	larvae	pupae	total	larvae	pupae	range	mean
Without food															
10	100	$L_{II \to III}$	19—23 V	10	10	0	0	90	90	0	0	0	0	5—10	6.1
10	100	L_{IV}	29—30 V	55	7	14	34	36	36	0	9	4	5	6—11	8.9
With feeding on Aëdes larvae of instars II and III															
10	100	$L_{II \to III}$	19—25 V	53	0	51	2	37	37	0	10	1	9	10—14	11.9
10	100	L_{IV}	29—30 V	86	4	40	42	11	11	0	3	0	3	7—12	9.7

The author expresses gratitude to his co-worker, A. N. Berzinoi, for great help in obtaining material and conducting tests, and to co-workers in the Department of Parasitology, Karelian Branch, Acad. Sci., USSR, for aid in selecting the location and in organizing the works.

Experiments on Intraspecific Relations in Larvae of Cryophila, Mochlonyx and Chaoborus

In setting up the experiments we began with the premise that with an equal number of larvae in the same volume of water, viz.,with the same population level, presence or absence of food should exert an influence on the degree of acuteness and competitiveness in the relations between the experimental larvae. For this reason parallel tests were set up for each species, without food and with food given in surplus quantities (larvae of Aëdes.)

Comparisons of the results of these parallel series of tests permitted the evaluation of the presence or absence of selective ability in the larvae in catching their prey, and in connection with this – the relationship in the occurrence of cannibalismand predation in the subjects investigated. Below are presented materials from tests on larvae of the same species, Cryophila lapponica Mart., Mochlonyx culiciformes De Geer and Chaoborus crystallinus De Geer, maintained collectively. Altogether in this division of 13 series, 124 tests were set up with 1209 larvae.

TABLE 3

Tests on the Collective Maintenance of Larvae of Cryophila lapponica

Total Nos.		Stage and size of larvae	Date at beginning of tests	Remaining alive to the end of the tests				Devoured			Dead from other causes			Duration of tests (in days)	
					of them				of them			of them			
tests	larvae			total	larvae	pupae	adults	total	larvae	pupae	total	larvae	pupae	range	mean
Without food															
10	100	$L_{II \to III}$	18 VIII	8	6	1	1	11	11	0	81	79	2	10—17	13.3
16	160	$L_{II \to III}$	28 VII	18	16	0	2	37	37	0	105	105	0	18—42	30
11	102	L_{IV}	22—25 V	100	20	1	79	1	0	1	1	0	1	6—15	10.7
With feeding: *– on daphne; **– on Aëdes larvae															
10 *	100	$L_{II \to III}$	18 VII	31	29	0	2	1	1	0	68	68	0	17—82	70
3 **	37	L_{IV}	22—23 V	36	3	16	17	0	—	—	1	1	0	4—14	7.7

TABLE 4

Tests on the Collective Maintenance of Larvae of Cryophila lapponica

Species	Total numbers		Stage and size of larvae	Date at beginning of tests	Remaining alive to the end of the test				Devoured			Dead from other causes			Duration of tests (in days)	
						of them				of them			of them			
	tests	larvae			total	larvae	pupae	adults	total	larvae	pupae	total	larvae	pupae	range	mean
Without food																
Cr . . .	10	100	L_{III}	25—26	1	1	0	0	99	99	0	0	—	—	3—6	3.3
M . . .		100	L_{III}	V	51	51	0	0	49	49	0	0	—	—		
Cr . . .	10	110	L_{IV}	28 V—	28	6	9	13	78	78	0	4	2	2	3—11	8.3
M . . .		110	L_{IV}	—1 VI	69	15	8	46	36	36	0	5	1	4		
With feeding on Aëdes larvae of instars III and IV																
Cr . . .	10	100	L_{IV}	28 V—	59	18	23	18	33	33	0	8	0	8	8—13	10.0
M . . .		100	L_{IV}	—1 VI	78	0	7	71	18	18	0	4	0	4		

TABLE 5

Tests on the Collective Maintenance of Chaoborus crystallinus De Geer (Ch) with Cryophila lapponica (Mart.) (Cr) and Mochlonyx culiciformis De Geer (M) (without food)

Species	Total numbers: tests	Total numbers: larvae	Stage and size of larvae	Date at beginning of tests	Remaining alive to the end of the test: total	of them: larvae	of them: pupae	of them: adults	Devoured: total	of them: larvae	of them: pupae	Dead from other causes: total	of them: larvae	of them: pupae	Duration of tests (in days): range	Duration of tests (in days): mean
Ch	6	44	L_{IV}	26—28	33	4	5	24	6	4	2	5	0	5	5—14	10.5
M	6	44	L_{IV}	V	8	4	3	1	33	33	0	3	3	0	5—14	10.5
Ch	4	17	L_{IV}	27—30	9	4	0	5	6	4	2	2	0	2	2—14	8
Cr	4	17	L_{IV}	V	3	2	1	0	13	13	0	1	1	0	2—14	8

Tests in each series were set up as far as possible in similar vessels and volumes of water (50, 75, or 100 cc) with equal numbers of larvae (5, 10, or 20 specimens). All tests were checked twice a day (morning and evening); at this time there was conducted a count of the living, examination of dead larvae and pupae, removal of emerged adult culicids, and a change of water and food. A test was considered completed when, with the absence of pupae in a vessel, one larva remained, and with the absence of pupae, the last of the larvae pupated.

Tests with Cryophila lapponica Mart. For the tests mature instar II larvae and freshly molted instar III larvae were taken at first, and somewhat later – mature instar III larvae and freshly molted instar IV larvae. Results and all essential data are presented in Table 1.

Late instar II and early instar III larvae in both series (without food and with food) on an average after 6 days devoured one another to the extent (to 89%) that one larva remained in each test. The reciprocal devouring took place so rapidly that not a single larvae, even in series with a surplus of food, succeeded in pupating, and in series without – succeded in passing into instar IV. The number remaining alive (6 in each series) expresses only the number of tests and cannot serve as a measure of aggresiveness of the larvae in relation to one another.

In tests with mature instar III and young instar IV larvae, 52% were eaten in the series without food and 47% of the larvae were eaten in the series with food. The decrease in the number of larvae eaten in the series with a surplus of food in comparison with the series without food is only 5%, which is very insignificant and lies within the error limits. In the series with food the reciprocal devouring of the larvae of Cryophila averaging 50% is evidence, in spite of a superabundance of food (larvae of Aëdes), of a complete absence in them during the capture of their prey of any ability to select between individuals of their own species and larvae of Aëdes.

An almost complete absence of eating of pupae is conspicuous. Though there were none in tests with young larvae, 80 larvae pupated in both series of tests with more mature larvae. Of this number only one was eaten.

As the hatching of the larvae of Cr. lapponica – a species having only one (spring) generation in a year– was simultaneous,it was impossible to repeat the tests in the same year. For this reason our data on the collective maintenance of larvae of this species are contained within the material presented.

Tests with Mochlonyx culiciformis De Geer. With this species, as in tests with Cr. lapponica, mature instar II and newly molted instar III larvae were taken and later, mature instar III and newly molted instar IV larvae.

As the hatching of M. culiciformis larvae, under the weather conditions of spring and beginning of summer in 1958, occurred in three waves,it was possible to set up tests with this species in several replications. Results of the May series of tests are presented in Table 2.

Just as in Cr. lapponica, late instar II and early instar III larvae of M. culiciformis in the series without food ate one another on an average after 6 days (with a range from 5 to 10 days), with the result that only one

larva remained living in each of 10 tests. Thus, toward the end of the tests only a few succeeded in molting into instar IV, but none pupated. In series with Aëdes larvae for food, selection was observed to exist in young larvae of M. culiciformis in comparison with larvae of Cryophila. The quantity of Mochlonyx larvae devoured, in absolute numbers and in percentage was significantly lower (37% instead of 89% in Cryophila). Thus the duration of the tests was much longer, so that more than half of the larvae in the experiment succeeded in pupating.

Of the mature instar III and young instar IV larvae maintained without food 36% were devoured, leaving alive 7 larvae and 48 pupae from which 34 culicids succeeded in emerging toward the end of the tests. In comparison with the analogous series of tests with Cryophila reciprocal devouring of larvae was noticeably less (by 16%). Even sharper were the differences in larvae receiving food. In these tests of 100 individuals only 11 were devoured, viz., less than one third the number in analogous tests with larvae of Cryophila. Thus 85% of the larvae pupated and from 82 pupae which remained alive 42 culicids succeeded in emergining.

In this manner, with similar conditions of maintenance and feeding, reciprocal devouring in larvae of Mochlonyx was observed at a significantly lower level than in larvae of Cryophila. Despite the fact that in tests with Mochlonyx there was a grand total of 183 pupae, not one of them was eaten.

Tests with Chaoborus crystallinus De Geer. All the species of the genus Chaoborus overwinter in the larval stage. For this reason predominately instar IV larvae are encountered in spring and with which tests were set up in Karelia. Supplementary tests with them and with earlier instars were conducted later on summer generations in Leningrad. The results are presented in Table 3.

In Chaoborus in series without food, even among young larvae at the end of instar II and beginning of instar III, devouring of one another was observed at a significantly lower level than in Cryophila and Mochlonyx: in the series of July 18, of 100 larvae 11 were devoured, and in the series of July 28, of 160 there were 37 (23.1%) devoured during a significantly longer curation of tests than in Mochlonyx. In the instar IV larvae, despite starvation, cannibalism was practically absent: of 102 larvae only 1 was eaten from a number that were just pupating.

In tests with food (daphne or larvae of Aëdes or Culex) reciprocal devouring was observed at a minimum level and only in larvae of instars II and III — 1 larvae was eaten from 100. Here the longest duration of tests was 82 days with an average of 70 days. Of 37 instar IV larvae not one was devoured.

In this way the larvae of Chaoborus, comparable to larvae of two other genera, catch and devour one another to a minimum degree. Along with this the periods are found to be the most extensive. For 49 larvae eaten in all the tests only one pupa was caught and eaten.

Experiments on Collective Maintenance of Larvae of Cryophila, Mochlonyx and Chaobarus

In addition to the preceding described group of tests for the clarification of interrelationships between the larvae of one species, several series of tests were conducted on the collective maintenance of larvae of Cryophila, Mochlonyx, and Chaoborus. These tests were to serve as controls for conclusions which would follow from the results of the above-selected tests. Aside from that, with the frequent finding of the larvae of the species investigated together in the same ponds, these tests could supply the key to the understanding of numerous relationships between these species in natural conditions.

Under collective maintenance of Cryophila and Mochlonyx larvae (Table 4) the latter were constantly devoured in significantly smaller numbers than the larger Cryophila. Consequently Mochlonyx larvae remained alive in large numbers, succeeded in pupating, and produced an emergence of adult culicids. Particularly representative are results for instar III larvae.

In order to solve artificially the question arising on the possibility, in these tests, of only larvae of the same species eating one another, a parallel series of 31 tests was set up in each of which were 1 larva of both Cryophila and Mochlonyx. Of this number after no later than a day, in 30 tests the smaller larvae of Mochlonyx devoured the Cryophila larvae maintained with them, and in only 1 test were the results reversed.

Thus, in tests on collective maintenance of Cryophila and Mochlonyx there occurred an extremely intensive consumption of Cryophila larvae by the larvae of Mochlonyx equal to the reciprocal eating of larvae of the same species.

These tests explain the small numbers of Cryophila usually observed in nature. Breeding together with Mochlonyx in the same ponds, despite the absence there of other predators in the plankton, they have, as a result of cannibalism and Mochlonyx eating their larvae, only half as much chance to pupate and produce an emergence of adult culicids. So, in our tests (Table 4) beginning with the same number of each species (310 larvae of each species) a total of 63 Cryophila pupated to the 132 pupae of Mochlonyx. In these tests not one pupa was eaten.

Data of tests on collective maintenance of Chaoborus larvae with larvae of Mochlonyx and Cryophila are given in Table 5.

These tests, despite their small numbers owing to the shortage of Chaoborus larvae, also produced sufficiently definite results. In both series larvae of Chaoborus were devoured in fewer numbers than larvae of the other species maintained with them. Consequently 3-4 times more of them remained alive at the end of the tests than of the larvae of Cryophila or Mochlonyx.

Results of the tests conducted on the collective maintenance of larvae of different genera confirmed the data obtained in series of tests on the collective maintenance of larvae of one species from each of the experimental genera. Larvae of Cryophila were devoured in the largest numbers larvae of Chaoborus in the smallest, and larvae of Mochlonyx occupied an intermediate position.

DISCUSSION OF RESULTS

The tests conducted indicate that intraspecific relations, in predaceous larvae from representatives of three related genera in the subfamily Chaoborinae, are expressed in the form of direct devouring of one another by individuals of the same species. However, the degree of acuteness of these relations in representatives of different genera differs sharply. In Cryophila they are distinguished as most acute. Cannibalism is manifested in them in the sharpest form. In Mochlonyx the acuteness of intraspecific relations is noticeably reduced, and in Chaoborus they are the least acute. How can the recorded differences be explained? For the answer it is necessary, even though briefly, to study comparatively several of their main adaptations to pelagic living during a predaceous type of feeding.

Special adaptations for defense against attack by predators, found in larvae of bloodsucking culicids of the subfamily Culicinae, are absent in larvae of the subfamily Chaoborinae. In all larvae of the subfamily Culicinae numerous body setae create around them a sensory zone which warns of the approach of danger. The larvae react sensitively to external disturbances with a rapid descent from the surface of the water to the bottom. In larvae of various genera of the subfamily Culicinae, breeding in ephemeral reservoirs with a small volume (hollows of trees, axils of leaves, calyx of flowers, etc.), there are similar adaptations that are widely distributed (Monchadskii, 1936, 1937, 1939). They are expressed either in a sharp elongation in the rows of body setae, significantly increasing the sensory zone around the larvae (larvae of Orthopodomyia, Aëdes alectorovi Stack. and others) or else, the reverse, in shortening them and turning them into sturdy spines, giving the larvae the appearance of a hedgehog (Aëdes geniculatus Ol., Aë. echinus Edw., Aë. galloisi Yam. and many others). In the larvae of a list of genera and species (Megarrhinus, Orthopodomyia) these adaptations often accompany the appearance of strongly sclerotized shields on the dorsal and lateral sides of the segments.

In the larvae of Chaborinae similar defensive adaptations are absent. Their body setae are greatly shortened, and in the process of individual development, with each subsequent line they become not relatively, but absolutely shorter. Such reductions in chaetotaxy in larvae of bloodsucking culicids renders an unconquerable resistance to their movement, as a consequence of which they achieve all their rapid movements with the hind end forward, which excludes the possibility of the predator catching its victim.

Organs for attacking and grasping prey (antennae, labrum, epipharynx, and mandibles) in the larvae of Cryophila, Mochlonyx, and Chaoborus are arranged not only monotypically (Meinert, 1886; Peus, 1934; Monchadskii, 1936, 1939), but so precisely that representatives of each of these genera may catch, hold and swallow down a victim equal to their own size and even somewhat larger, not to mention smaller objects. For this reason they may catch and eat one another with the same degree of probability and have no noticeable advantage in this respect.

Thus the differences in acuteness of intraspecific relations observed in the tests with larvae of Cryophila,

Mochlonyx and Chaoborus cannot be explained by the presence in them of a different development of defensive adaptations, nor by the greater or lesser perfection in the organs of attacking and grasping the prey. The explanation of these differences should be sought in general nonspecific adaptations of the larvae to pelagic living.

A key to understanding these relations lies in the clarification of the role of vision in the larvae when catching its victims. Predaceous culicid larvae are guided in this by visual perception. They lunge at any animal moving in their immediate vicinity (larvae of bloodsucking and other culicids, copepods, cladocerae, etc.). Possibly there may be some significance in water vibrations caused by moving animals, and in perception by sensory setae and other receptors. However, similar disturbances make it impossible for the larvae to determine accurately the position of the moving source of these vibrations, which is necessary in order to catch the prey. For this reason, even under conditions of poor illumination, the organs of vision must by of greatest import during the catching and grasping of the prey.

The organs of vision in culicid larvae (Monchadskii, 1936, 1939) consist of a pair of simple eyes, arranged on the sides of the head and appearing even in the egg stage, in front of which are located primordia of the compound eyes of the adult insect which develop gradually in the process of metamorphosis. They are capable of function also in the larval stage. In Mochlonyx and Chaoborus pigmentation of the primordia of the compound eyes begins in larvae of instar II. In Cryophila just hatched from the egg the larvae already have well-pigmented primordia of compound eyes, the development of which progresses very rapidly and is practically completed while still in the larval stage. Their further development in the pupa concerns only dioptric elements. Considering the earlier and more pronounced development of compound eyes in larvae of Cryophila it should be assumed that their visual reactions are more precise than in larvae of Mochlonyx and Chaoborus.

The possession of the organs of vision permits the larvae to discern, besides gradations in intensity of illumination, only moving objects prominent in the general zone without details of their external form. For this reason predaceous culicid larvae attack and catch only moving prey, if during its movements it enters the predator's sphere of vision, viz., its immediate surroundings. Nonmoving objects do not attract their attention. From this ensues a broad potential possibility for predaceous larvae to catch without selection individuals of their own and other species.

In this manner the predaceous larvae capture and consume their prey without regard to their specific appurtenance and depend only on the physical possibility of locating, catching, grasping and eating them.

The absence of selective ability noted in the catching of prey by predaceous culicid larvae also lies at the basis of the intraspecific relations accumulating between them under collective habitation. For this reason greater or lesser transparency and immobility of the larvae determines, primarily, their visibility in the depths of the water and, consequently, the degree of probability of being caught and eaten by their fellows or other predators.

Since the cuticular covering of culicid larvae is not pigmented and is transparent, the coloration of the latter depends on pigmentation of internal organs, primarily the fat bodies (Monchadskii, 1936). Of the experimental larvae the least transparent were the larvae of Cryophila. In instar I their fat bodies are already noticeably pigmented and the larvae are not transparent. With each following stadium the coloration of the fat bodies is intensified and the larvae, of a yellowish brown hue, are practically indistinguishable, in the degree of transparency, from the Aëdes larvae developing simultaneously with them in the same reservoirs. The pigmentation of the head stands out particularly, with the large black, hemispherical compound eyes (Monchadskii, 1939).

Instar I Mochlonyx larvae are entirely transparent and are practically invisible. Even in larvae of instar II body coloration is almost absent, and the pigmentation of hard chitinized structures – the head and respiratory tubules – is very light. In instar III they become light brown and the body is semitransparent. They remain this way also in instar IV, colored with brown hues of various intensities.

The larvae of Chaoborus are transparent throughout all the larval stages. Only in mature instar IV larvae the fat body in some species may be slightly colored with a yellow or smoky hue.

Thus, the most noticeable in the water because of their coloration and lack of transparency are larvae of Cryophila, the intermediate position is occupied by the semitransparent and lightly pigmented larvae of Mochlonyx, and the least noticeable are the transparent and practically almost colorless larvae of Chaoborus.

Predaceous larvae in the genera of the subfamily Chaoborinae taken for the tests do not actively search out their prey, but as a rule they belong to the numbers of predators that look out for their prey. With this, the more exactly equal the specific gravity of the larvae and the water, then in a more immobile condition will the larvae be when looking out for prey. In the larvae of Chaoborinae there are diverse developments in hydrostatic adaptations in the form of bubble-like dilations of the main tracheal trunks, which in various degrees provide them with the possibility of habitation and movement in the depths of water (Monchadskii, 1936, 1939).

Larvae of Cryophila have a pair of such bubble-like dilations in the thoracic division and 2 pairs in segments VI and VII of the abdomen. In larvae of Mochlonyx, in addition to the pair of bubble-like dilations in the thorax, there is a pair of dilations in segment VI of the abdomen. In larvae of Chaoborus, with a reduction of the tracheal system there remain only a pair of thoracic and a pair of abdominal bubbles, which according to investigations of Gelei (Gelei, 1928) may alter their volume and thus change the specific gravity of the larva, depending on water temperature, by means of changing the areas of pigmented epithelium covering them as a consequence of absorbing various amounts of falling thermal rays.

The specific gravity of Cryophila larvae is always somewhat less than the specific gravity of water. For this reason, when they are at rest they rise slowly and passively to the water's surface. When the larvae reach a depth of 5-10 cm from the surface they rapidly descend with a downward incline with a stroke of the lateral surface of the fin, changing the direction of movement by 180 degrees. At first the steep (to 45 degrees) active movement under the influence of dying inertia becomes increasingly more inclined and after 30-45 seconds it again enters the passive ascent (Monchadskii, 1939). In this way the larva normally moves up and down in the same column of water, never remaining inactive. Catching of prey occurs most often during the passive ascent. Considering the relativity of movement to visual perception, the larvae may also catch immobile prey at the time of ascent. During the descent the larvae seldom catch their prey and then only if it is mobile.

The hydrostatic mechanism in Mochlonyx and particularly in Chaoborus is more precise than in Cryophila and provides equality between their specific gravity and water, as a result of which they may retain complete immobility for an unlimited time in its depths. Larvae of Chaoborus, as mentioned, may, in connection with changes in water temperature and intensity of radiation, alter their specific gravity and consequently shift in a vertical direction.

These features determine in the larvae of Mochlonyx and Chaoborus the ambush type of attack peculiar to them. Though normally found in a completely immobile state, they pounce with lightening speed on prey moving near them.

CONCLUSIONS

The analyses carried out indicate a direct causal relation between the degree of acuteness and intensity of intraspecific relations in the larvae of Cryophila, Mochlonyx, and Chaoborus and the features of their adaptation to pelagic living: degrees of their transparency and hydrostatic equilibrium. In fact, in nontransparent and constantly moving larvae of Cryophila intraspecific relations are the most acute and intense; they are to the highest degree subject to attack which from their own standpoint is similar to that of predators of other species. In the transparent Chaoborus larvae which are immobile in the depths of water these relations are least acute; though immobile, but semitransparent in the second half of the larval stage, Mochlonyx occupies an intermediate position.

It is generally known that transparency and hydrostatic equilibrium are characteristic peculiarities of the overwhelming majority of planktonous organisms, without relation to their systematic position. For this reason it is necessary to examine both of these features as being the result of general adaptations of the organism to a pelagic life. As it is precisely these features that determine, in our case, the degree of acuteness in intraspecific relations, it should be considered that their influences on the general course of the evolutionary process of the group of genera investigated by us, if they have a place, occupy only a very subordinate position in comparison with the decisive actions of the general conditions of existence. In the pelagic larvae of Chaoborinae the features of their intraspecific relations accumulated and developed, as a result of adjustments to general conditions of their existence, in complete correspondence with the level of adaptation to the latter.

In the subfamily Chaoborinae differences between adult insects are significantly less distinct than between larvae. The adult culicids of this subfamily have a list of primitive traits, relating them, for example, according

to the structure of the head and mouth parts, to ancestral forms. At the same time the larvae are extremely specialized and their differences from ancestral forms are very great (Monchadskii, 1936, 1937, 1939). For this reason the supposition that the larval stage was leading in the process of evolution in the subfamily is entirely natural. The evolution of the larvae in the genera investigated was directed toward increasingly profound adjustments to a pelagic life and a predaceous type of feeding. These adjustments are most precise in larvae of the genus Chaoborus, and the least in Cryophila; Mochlonyx larvae occupy an intermediate position (Wesenberg-Lund, 1908; Monchadskii, 1937, 1939).

Considering such a general direction of the evolutionary process and the results of our tests, it is possible to suppose that in the process of evolution of these branches of the subfamily Chaoborinae parallel changes occurred in intraspecific relations toward eliminating their acuteness. This supposition is indirectly confirmed by the presence in the subfamily Chaoborinae of another path of adaptation, leading in the process of evolution toward complete removal of acuteness in intraspecific relations. Larvae of the nearctic genus Eucorethra, E. underwoodi (Johannsen, 1903; Edwards, 1932) adapted to predation under conditions of habitation not in the depths of the water, but in the film immediately below its surface. Under these conditions aquatic organisms do not serve them as food, but instead small insects, mainly diptera, which fall on the surface of the water. A secondary development in the process of evolution of this genus, of transferring the sphere of hunting from an aquatic medium to an atmospheric medium, completely excludes the possibility of E. underwoodi larvae catching and eating one another.

The present work is the first of a proposed series of investigations. In it a list of questions on complex biological problems of intraspecific relations could not be touched upon, even in relation to the limited group of subjects investigated. In particular, there was left without explanation a fact, repeatedly mentioned in the work, of an almost complete absence of attacks on pupae, which is remarkable from the standpoint of the extremely aggressive larvae of the species investigated. Subsequent reports shall be devoted to this and some other questions.

SUMMARY

Some experiments were carried out with the predaceous pelagic larvae of Cryophila lapponica Mart., Mochlonyx culiciformis De Geer and Chaoborus crystallinus De Geer, representatives of all the three genera in the subfamily Chaoborinae found in the Palaearctic region.

Each species of larvae of the same age were maintained in each series of tests in equal numbers (5, 10, 20) in vessels of equal volume. In one series of tests the larvae were kept unfed, in the other they received an unlimited supply of food (Aëdes larvae of corresponding size). A test was considered completed when the last of the experimental larvae pupated or remained alone. Data from the tests are given in Tables 1, 2 and 3.

Intraspecific relations of the larvae of the three related genera examined, appear, under the conditions of collective maintenance, to differ considerably: These relations are most acute in Cryophila larvae, least acute in Chaoborus. The Mochlonyx larvae occupy an intermediate position. These differences in degree of acuteness of intraspecific relations are closely related to the level of larval adaptation to pelagic life under conditions of predaceous feeding. Of these adaptations transparency of the body and hydrostatic functions of the tracheal system are of greatest importance. The Chaoborus larvae are the most specialized (they are almost completely transparent and immobile in water); the immobile Mochlonyx larvae are transparent only in instar I and then gradually become opaque; the Cryophila larvae are opaque beginning with instar I, and being lighter than water they move constantly. As the catching of victim larvae is guided only by vision, lesser transparency and greater mobility are disadvantageous to them. Thus Cryophila larvae devoured one another in the greatest numbers, Chaoborus larvae, in the fewest numbers and the larvae of Mochlonyx occupy an intermediate position. Under conditions of collective rearing of larvae of two different species (Cryophila and Mochlonyx and the other) similar data were obtained (Tables 4, 5) which confirmed the previous tests. In 30 of the 31 tests with 1 Cryophila and 1 Mochlonyx larva together, the Cryophila larva, despite its greater size, was devoured. In these tests the Chaoborus larvae were also devoured in fewest numbers.

In the process of evolution in the subfamily Chaoborinae (Monchadskii, 1937) the imaginal stage changed little. The larval stage was the leading one. The evolution of Cryophila, Mochlonyx and Chaoborus larvae was directed to a most profound adaptation to a pelagic life and predaceous feeding. These adaptations are most

specialized in the Chaoborus larvae. Considering this direction and the results of the tests, it is possible to suppose that in the process of evolution of this branch of the subfamily Chaoborinae the changes in intraspecific relations were directed toward elimination of their acuteness. This supposition is indirectly confirmed by the presence, in the subfamily Chaoborinae, or another type of adaptation characteristic of the nearctic genus Eucorethra. The larvae of Eucorethra underwoodi adapted to predation under conditions of habitation directly under the surface layer of the water. Small insects settling on the water surface generally serve as food for them. The secondary transference, in the process of evolution, of the sphere of hunting from an aquatic medium to an atmospheric one entirely excludes the possibility of the larvae catching and devouring one another. Acute intraspecific relations became completely eliminated.

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THE RELATIONSHIP OF THE SEASONAL DEVELOPMENT OF APANTELES GLOMERATUS L. TO THAT OF ITS HOST PIERIS BRASSICAE L. IN DIFFERENT GEOGRAPHICAL POPULATIONS

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The parasite is so intimately linked with the host organism that, so far, any effect that the outside world may have on the former has been considered to stem directly from its effect on the host. After analyzing the enormous volume of literature on the relationship between parasitic insects and their hosts, Salt [1941] came to the conclusion, that even such specific, physiological properties of the host as its diapause are "transmitted" to the parasite and are the direct cause of the interruption in the latter's development.

A certain lack of dependence on the host's physiology by parasites reacting to external environmental stimuli, such as temperature and photoperiodism, was probably first noted by Geispits and Kyao [1953] and Smith and Langston [1953]. This was later confirmed by Lees [1955] and Maslennikova [1958]. The aforementioned authors obtained results which made it quite evident that the phenological synchronization between the development of the host and parasite, particularly that of the onset of diapause in both, could be attained in two different ways: either by a complete dependence of parasite's development on the physiological state of the host or alternatively, by an independent reaction of both partners to the influence of external factors.

In this article, which is concerned with an investigation into the photoperiodic reaction of two distinct, geographical populations of the parasite Apanteles glomeratus L. and of its host Pieris brassicae L. we shall demonstrate that diapause in the parasite is the direct result of photoperiodicity in the outside world and is completely independent of the host's physiology. An analysis of the causes and conditions of synchronization in the developmental cycle of the parasite is included in the article.

MATERIALS AND METHODS

The investigation was conducted using populations of Apanteles glomeratus from the Leningrad and Sukhumi areas. The development of the parasite took place in the commonest host, namely Pieris brassicae, which was collected from the same two areas. Sukhumi and Leningrad populations of the cabbage white butterfly, obtained in the field, were used throughout the experiments. Caterpillars of both populations were infected in their first and second instars with Apanteles from the Leningrad area and from the Sukhumi area. Thus we were able to investigate the photoperiodicity reaction of Leningrad parasites developing in Sukhumi and Leningrad hosts and Sukhumi parasites developing in the same two types of host.

The caterpillars were reared on cabbage and kept in 0.5-1.0 liter glass vessels, 15-20 caterpillars per vessel. The food was changed daily. Immediately after cocooning, the parasites were transferred to test tubes and maintained under experimental conditions until the imagos emerged. Several days after the emergence of Apanteles, the remaining cocoons were dissected.

The number of individuals used in the experiments usually exceeded 100, although in several cases it was rather less but always more than 25.

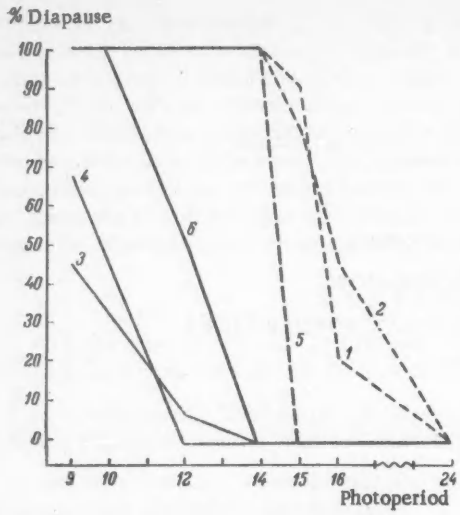

Fig. 1. Photoperiodic reaction of Sukhumi and Leningrad populations of Apanteles glomeratus L. and of its host Pieris brassicae L. 1) Dependence of diapause on length of day for Leningrad Apanteles developing in Leningrad Pieris; 2) the same for Leningrad Apanteles in Sukhumi Pieris; 3) the same for Sukhumi Apanteles in Sukhumi Pieris; 4) the same for Sukhumi Apanteles in Leningrad Pieris; 5) the same for nonparasitized Leningrad Pieris; 6) the same for nonparasitized Sukhumi Pieris.

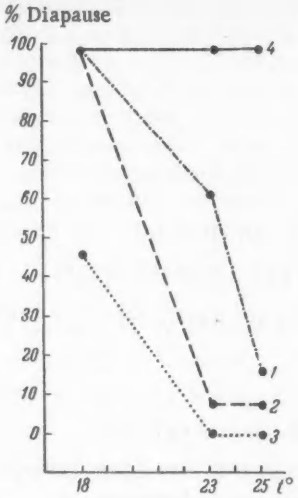

Fig. 2. Influence of temperature on the diapause of Leningrad and Sukhumi populations of Apanteles glomeratus L. developing in Sukhumi Pieris brassicae L. 1) Dependence of diapause on temperature among nonparasitized cabbage white hosts; 2) the same among Leningrad Apanteles in Sukhumi cabbage white hosts; 3) the same among Sukhumi Apanteles in Sukhumi cabbage white hosts; 4) the same for nonparasitized Leningrad cabbage white (after Maslennikova [1958]).

The control series of experiments were carried out in a thermostatically controlled room at a constant temperature of 18° (variation in temperature did not exceed ± 0.2°); the room was illuminated by a fluorescent lamp D.S. 30. The experimental material was housed in a comparable room, in which the regular daily regime of illumination was given automatically.

Part of the experiments were conducted at 23° and 25° in special automatically regulated photo-and thermorhythmic chambers.

The work was carried out during the summer of 1958 in the Entomological Laboratory of the Biological Institute at Stary Petegrof.

Relationship between Photoperiodic Reaction and Geographical Form

The photoperiodic reactions of Apanteles and Pieris were investigated at a temperature of 18°, using both Leningrad and Sukhumi populations. The results of these experiments are set out in Fig. 1.

The diapause of both parasites and hosts under the conditions of the experiment was found to be directly related to photothermic conditions: when the length of daylight exceeded 16 hours (long-day conditions) neither partner underwent any diapause, whereas under short-day conditions diapause occurred. Under conditions of illumination between 9 and 16 hours per day, the number of individuals undergoing diapause increased in direct proportion to the decrease in number of hours of daylight, a fact that had been noted previously in the literature for the Leningrad population of Apanteles (Geispits and Kyao, 1953; Maslennikova, 1958).

It may be seen from Fig. 1 that all the categories under investigation differed strongly in respect to their

photoperiodic reaction. Thus the photoperiodic reaction of Sukhumi Apanteles developing in Sukhumi caterpillars (curve 3) was quite different from the reaction of uninfected hosts from the same source (curve 6). The critical day length for the parasite lies around 9 hours, whereas for the host it is 12 hours. Moreover the Sukhumi parasites, in contrast to their hosts, only give a 45-70% diapause rate, even under conditions of 9 hours illumination per day. Complete diapause throughout the Sukhumi population of Apanteles was never attained under the conditions of our experiments. A similar difference in the photoperiodic reaction of parasites and hosts may be observed in the Leningrad populations (curve 1 and 5); these results are in full agreement with those obtained at an earlier date, using hosts and parasites from the same region (Maslennikova [1958]).

On comparing the photoperiodic reaction of Leningrad (curve 5) Pieris with Sukhumi (curve 6) Pieris, it is seen that both populations differ markedly from the normal photoperiodic reaction, i.e., the reaction which is characteristic of many other species (Danilaevskii, [1956, 1957a, 1957b]. The critical photoperiod for the Leningrad cabbage white caterpillars lies between 14 and 15 hours of daylight, whereas that for the Sukhumi caterpillars is in the region of 12 hours; the threshold value for the latter is ill-defined, but full diapause is only obtained under conditions of 10 hours of daylight.

An even greater difference from the normal photoperiodic reaction is shown by the Leningrad (curves 1 and 2) and the Sukhumi (curves 3 and 4) Apanteles, irrespective of the geographical form of host in which they develop. It follows that the nature of the photoperiodic reaction in Apanteles is a genetically determined characteristic and is quite independent of the host.

Of special interest is the fact that in many cases the photoperiodic reaction of the parasite is quite the opposite of that shown by the host. Thus, Sukhumi cabbage white hosts under conditions of 18° and a 14 hour day (curve 6) develop without any diapause, whereas the Leningrad Apanteles parasitizing them (curve 4) under the same conditions show a 100% diapause. The Leningrad cabbage white hosts under a 12 and 14 hour per day regime show a complete diapause (curve 5) whereas the Sukhumi parasites developing within them, under the same conditions do not show any diapause at all. These facts prove conclusively that the photoperiodic reaction of Apanteles is absolutely independent of the host, and is obtained in direct response to photorhythmic changes in the environment.

What at first glance appears to be a joint photoperiodic reaction of parasite and host, belonging to the same geographical population, is actually the result of similar but quite independent adaptations of the partners to seasonal conditions.

The Relationship between the Temperature Reactions of Different Geographical Forms

With the aim of elucidating the effect of temperature on diapause in the geographical forms of Apanteles, we carried out experiments at 18°, 23° and 25°, keeping the light regime constant at a 9-hour day. The results obtained are set out in Fig. 2. The Leningrad population of cabbage whites all exhibit diapause within the temperature limits 15 to 25°, when short-day illumination is employed (curve 4). The temperature threshold for their photoperiodic reaction lies between 27 and 29° (Maslennikova [1958]). At 18° and 9 hours daylight, the percentage of individuals undergoing diapause in the Sukhumi population of cabbage white equaled 100%; raising the temperature to 25°, however, reduced this percentage considerably (curve 1). The percentage of individuals undergoing diapause among Sukhumi and Leningrad populations of Apanteles developing in Sukhumi cabbage white caterpillars, both underwent a marked decrease with increase of temperature, but the two geographical populations differed in the nature of the decrease. The Leningrad Apanteles at 18° and with a 9-hour day (curve 2) gave 100% diapause but between 23° and 25° the percentage diapause did not exceed 10%. Among Sukhumi parasites, in which even at 18° and with a 9-hour day there was only 50% diapause, an increase in the temperature to 23° did away with diapause completely. Under conditions of round-the-clock illumination both forms of parasite and host developed without diapause within the temperature limits of the investigations.

From what has been said above, it follows, that in the investigated geographical populations of both parasite and host there are marked differences between the two populations as regard their temperature reactions as well as their photoperiodic reactions.

DISCUSSION

The presence of wide differences in photoperiodic and certain other reactions among different geographical populations of a single parasite is a phenomenon which has great theoretical importance and possesses a wide range of practical possibilities (Danilevskii [1956, 1957a, 1957b]).

Our discovery of different norms for photoperiodic and temperature reactions among parasitic insects has a special technical significance, particularly for those concerned with problems of acclimatization and introduction. On the basis of the facts which we have discovered, it is possible to state that if Sukhumi Apanteles were transferred to Leningrad conditions they would develop without diapause until November, when the critical daylength of 9 hours obtains. The onset of subzero temperatures in nature would then find the parasite unprepared for hibernation and in a state of active development. Moreover, by the end of September in the Leningrad area there have ceased to be any young caterpillars of Pieris brassicae suitable for parasitization by Apanteles. Thus the Sukhumi population of Apanteles would be doomed to extinction under Leningrad conditions. This conclusion is in complete agreement with the data obtained in the experimental transfer of a Sukhumi population of Acronycta rumicis L. to Leningrad conditions, an attempt at acclimatization which proved impossible (Danilevskii [1957b]).

The material in this paper enables us to analyze the causes of the synchronization between the developmental cycle of Apanteles glomeratus L. and those of its hosts Pieris brassicae L. and Aporia crataegi L. Observations both in the field and under experimental conditions (at temperatures of 18-20°) suggest that there is relative synchronization of development between Apanteles and its host, Pieris, (when both are derived from a single geographical area) and that this synchronization is the result of an independent reaction on the part of the parasite and its host, in direct response to ecological factors in the environment. The independent nature of the reaction is revealed most clearly when parasites are raised in hosts derived from a different geographical region to that of the parasite. The experimental results obtained suggest that although Apanteles spends the whole of its development from the egg to the prepupal stage within the body of the cabbage white caterpillar, the latter is merely a source of food for the parasite and cannot be regarded as its "environment".

The synchrony of seasonal development between this parasite and another host – Aporia crataegi L. – is achieved in an entirely different way; namely by an absolute dependence on the physiological state of the host. Here the development of Apanteles in its early instars is fully conditioned by the onset of diapause in Aporia (Maslennikova [1958]).

Both the described methods lead to a phenological synchrony of development between parasite and host, without which the parasites existence would be impossible.

The wide difference in photoperiodic reaction between geographical forms of the parasite and of its host lead one to think that the adaptation of the parasite to local ecological and geographical conditions has been achieved independently of that of the host.

Finally it must be stressed that the use of different geographical populations can serve as an extremely valuable tool for the elucidation of the extent to which parasites are dependent on their hosts; a tool which is all the more valuable because it does not entail any real interference with the insects themselves.

SUMMARY

As it has been established by this investigation, the Sukhumi and the Leningrad populations of the parasite Apanteles glomeratus L. and its host Pieris brassicae L. differ very widely in their response to the changes of photoperiod and temperature.

The differences in the norm of the photoperiodical reaction between the geographical populations of the parasite are much more conspicuous than those in the host, which indicates that the course of the adaptation of the parasite to the local ecologicogeographical conditions was independent of the same process in the host.

The character of the photoperiodical reaction of different geographical populations is hereditary and perfectly independent of that in the host. In several instances the responses of the parasite and the host to the same photothermic conditions are reverse.

The phenological synchronization of the life cycles of A. glomeratus and P. brassicae is the result of the

independent responses of both partners to the environmental factors. On the contrary, the synchrony of the seasonal development of this parasite with another host, Aporia crataegi L., is the consequence of the absolute dependence of the early instars of A. glomeratus on the physiological of the host.

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THE COMPARATIVE SIGNIFICANCE OF TWO WAYS OF FOOD-SCENT TRANSFER INTO THE HIVE (ON THE BODY AND IN THE CROP) IN THE RECRUITING ACTIVITY OF HONEYBEES

N. G. Shaposhnikova

Frisch [1923] showed that the scent of flowers served not only as an aid in the search for food sources, but also, because of its being carried into the hive with the food, as an important factor in the process of recruitment. The recruitment signal is designed to inform the bee population within the hive, not only of the presence of a particular food source but also of its location. Novice bees perceive this scent and will search for it in the field. Thus the scent of a particular food source, brought into the hive by forager bees, is one of the most important means of imparting information between bees. It guarantees the success of collective effort among bees and is an important social factor.

Frisch wrote in 1943 that the dancing bees communicated the scent of food in two ways: 1) other bees perceive the scent by touching the body of the forager with their antennae; 2) during intervals between their dancing the foragers feed other bees on the contents of their crops (nectar which bears the scent of flowers). It has been demonstrated that the dorsal surface of the bee's body retains the scent of flowers for a long time (Steinhoff [1948]).

Thus the bee dancers carry into the hive the scent of flowers they have visted, both on their body and in the nectar they have collected.

Thirty years ago Soviet scientists first worked out a method for directing bees to plants of economic importance in order to ensure the pollination of the latter; this method, according to Gubin and Smaragdova [1940] made use of a conditioned reflex based on the forager bees bringing into the hive the scent of the flowers which it was desirable they should pollinate.

Frisch [1950] persuaded bees to visit particular cultivated plants by transferring the smell of their flowers to the hairy covering on the back of the forager bees; in order to do this he used a special feeding apparatus of his own design. The feeding apparatus consisted of 3 compartments: the middle one containing flowers of the plant to which the bees were to be attracted, the lateral ones containing syrup.

In their efforts to reach the syrup, the bees had to pass through the middle chamber of the feeding apparatus and thus made their way between the flowers, with the result that their bodies became saturated with the scent of the latter. After this the forager bees begin their dance. Other inhabitants of the hive became aware of the scent adhering to the bodies of the foragers, and flew off in a search for flowers similar to those in the feeding apparatus.

In order to ascertain whether the dancing bees carried the smell of the flowers they had visited, both on their bodies and on the nectar they had collected, Frisch carried out the following experiments. He fed odorless sugary syrup to marked bees which were flying to cyclamen flowers. In order to prevent the sugary syrup being contaminated with the scent of cyclamen, he placed it in small spherical glass containers from which the bees could only obtain the syrup through a narrow slit. The bees, therefore, carried only the cyclamen odor on the surface of their bodies; nevertheless other bees recruited by the experimental forager bees, searched for flowers

TABLE 1

Differental Recruitment by Forager Bees with One Scent on the Body and a Different One in the Crop (mean of 4 experiments)

Experiment number	Distance from hive, in mm	No. recruited in 2 hours			Remarks
		with scent on food in crop	with scent on body	control scent	
1	100	35	71	1	Settled but proboscis not extended
2	300	42	88	1	The same
3	600	36	77	2	The same

TABLE 2

Comparison between the Recruitive Effect of Body Scent and Scent of Food in Crop (mean data from 4 experiments)

No. of experiments	Distance from hive	Interval of time during which counts of recruits were made	No. of recruits attracted			
			by food scent		by body scent	
			total no.	mean no. per minute	total no.	mean no. per minute
1	100	50 min	63	1.2	136	2.7
		1 hr 30 min	140	—	398	—
2	300	50 min	132	2.6	172	3.4
		—	—	—	—	—
3	600	50 min	62	1.2	161	3.2
		1 hr	87	—	220	—
4	800	50 min	19	0.4	39	0.8
		1 hr 20 min	50	—	76	—
5	1000	50 min	20	0.4	50	1.0
		1 hr 10 min	35	—	65	—

with a cyclamen scent. In a further series of experiments he fed sugary syrup which had been saturated previously with cyclamen scent to forager bees visiting cartons devoid of any scent. In this way, the forager bees could transmit the scent only by way of the nectar in their crops. Once again, however, they recruited other bees to the search for cyclamen.

In 1950, Frisch carried out experiments designed to show the relative effectiveness of the two methods of scent transfer by bees, from the standpoint of recruiting other bees to the quest for that scent. He attempted to solve this particular problem by feeding bees which were flying to cyclamen flowers with sugary syrup previously permeated with the scent of phlox. As a result of this treatment the dancing bees carried on their bodies a scent

different from that of the nectar in their crops. Later, he noted the number of novice bees recruited to the quest for cyclamen as compared with the recruitment to the quest for phlox. Frisch stated the results of his experiments as follows: "If the feeding place was situated near to the hive, then the other bees influenced by the dancers would fly to cyclamen flowers almost as frequently as to phlox. If, however, the feeding place was situated at a distance of approximately 800 m from the hive, the new recruits were only interested in phlox flowers, the scent of which was carried in the nectar in the crops of the dancing bees".

"Evidently during the time taken for the return flight the body of the forager bee is likely to lose its scent of cyclamen" – thus Frisch explained his results.

The aim of our own research (like that of Frisch) was to determine the comparative effectiveness, for the purpose of recruitment, of the smell carried into the hive on the body of the bee and that borne on the nectar in the crop, with, however, the difference that the odors on the body and in the food were of artificial origin – concentrated essences. The solution of this problem is of considerable importance in exploiting different methods of influencing the food-seeking activities of bees, for among such methods the artificial reinforcement of the scent of food sources is beginning to play an all-important part.

The work was carried out in two series of experiments. We undertook an experimental assessment of the relative importance of the scent carried on the food as compared with that carried on the hairy body of the foraging bees for recruitment purposes. In the first series of experiments, a single group of forager bees carried one scent on their bodies and a different one on the food within their crops. In the second series of experiments two, numerically equal, groups of bees were used; the first group carried the scent to the hive only on their bodies, while the second group carried it only in their crops. The number of bees recruited to the search for a particular smell was taken as a measure of the efficiency of that method of recruitment.

These experiments were carried out at two apiaries. The odorous substances employed in the experiments were aromatic essences, prepared at the A.I. Mikoyana Confectionary Works. The experiments were carried out during the summer of 1955 at the "Les na Vorskle" beekeeping station, Belgorod region.

Recruitive Value of Body Scent as Compared with Food Scent in Forager Bees

An automatic capillary feeding device, constructed by V. E. Bordanov, was employed in the first series of experiments. This feeding device was constructed in such a way that a bee, imbibing syrup from the small capillary orifice, could not get the scent of the food on its body. While the forager bees were consuming syrup from the automatic feeders, they imbibed one scent with their food and at the same time we placed a different scent on their bodies. In order to accomplish these two aims we introduced equal amounts of aromatic essence: in the first case, into syrup; in the second in vaseline which was smeared on the body of the forager bee. Thus each bee brought two different scents back into the hive; one in its crop, the other on its body. We were anxious to know which of the 2 scents recruited the greater number of novice bees. Was the scent carried on the nectar in the crop the more effective, or did the body scent draw a greater recruitment? The experiments were conducted at distances of 100, 300 and 600 m from the hive.

The preparative period of the experiment consisted of forming the experimental group of bees, and their visit to the automatic capillary feeder. In order to accomplish the above, syrup was placed in small vessels near to the hive so that the bees became conditioned to feeding at a given place. The food in the vessels was not scented in any way. After the bees had fed on this odorless syrup, they were trapped at the feeding vessels, marked and transferred in lots of 100, to specially constructed box-cages (height 6 cm length 18 cm, width 14 cm) on the experimental site. The bottom of the cage was of metal gauze and the roof was a sliding glass one.

At an earlier date (Shaposhnikova [1958]) the author had established that the majority of bees return to the place where they began their feeding, that during the "hungry condition" they wander about and that they obtain food at a definite distance from the hive. On the experimental site, the cages containing the marked bees were covered with gauze and the automatic feeders placed on the gauze, through which the forager bees consumed the syrup from the capilliary apertures; later the bees were returned to the hive. The capilliary feeders were placed on portable stands, 70 cm high and 25 × 15 cm in area. The food was scented with a single odor, and the body of the bee was treated with a different odor.

At a radius of 2 m from the feeding places, there were set up stands on which empty vessels were placed;

the empty vessels were scented by 1) the food odor, 2) the odor placed on the body of the forager bee and 3) a control odor different from the other 2.

After ensuring that there was a constant passage of the bees from the hive to the feeding place, the numbers of recruited bees appearing at the scented empty vessels were recorded. Only those recruited bees which actually settled on the vessels and extended their tongues toward the scented area, were noted. After being recorded, the recruits were captured and retained until the end of the experiment using those particular scents.

The experiment was repeated 4 times. Mean figures were obtained and used in the results. Each experiment lasted for 2 hours and a new feeding place was then chosen for the next group of forager bees to be marked and scented. The following aromatic essences were used in the experiments: cherry, pear, rum, almond, tangerine, orange, raspberry, strawberry, barberry, plum, and black currant. The order of utilization of these scents was such that if in one experiment a particular aromatic essence was placed on the food, in the next experiment the same essence would be placed on the body of the forager bees and vice versa.

The experiments were carried out in woodland, 4 km from the apiaries themselves.

The results of the experiments, conducted at distance of 100, 300 and 600 m from the hive, are given in Table 1.

The data given in this table show that the number of bee recruits was twice as high in the case of body scents as compared with the scent on the food in the crop.

On the basis of these results it is possible to state that the scent brought into the hive on the bodies of the forager bees is much more important for recruitive activity than the scent carried in the crop. This can be explained as follows: at the time when the recruitive dance is being performed by the foragers there are a great many other bees surrounding the foragers from which the body scent emanates. Throughout the dance bees are touching the abdomen of the foragers with their antennae and thus become aware of the body scent whereas only during the short interval between dances are bees fed by the foragers and thus become aware of the food scent.

Comparison between the Recruitive Effect of Body Scent and Scent on Food

The second series of experiments was conducted with the same aim in view, but the method employed was somewhat different. Whereas in the first series a single group of forager bees was employed, in the second series 2 groups were used, so as to exclude any possibility of mingling or confusion between the body scent and the food scent during the recruitment process. Bees were collected at a "reserve collecting point", placed in the box cages 100 at a time, and transferred to the experimental site as described above. The term "reserve collecting point" denotes a place situated about 250 m from the hive, to which 400-600 bees of a given stock had been trained to come by conditioning them over a period of 20 or more days. Bee scouts visited this place throughout the day and if any food was placed there, they immediately returned to the hive to report its appearance; this enabled us to collect a considerable group of forager bees for the experiment when they were needed.

The experiments were carried out at distances of 100, 300, 600, 800, and 1000 m from the hive, at 2 points 50 m apart for each distance. At the first point forager bees received only scented syrup from a capilliary feeder, no scent being placed on their body surface. At the second place scent was placed on the body surface of the bees, while they were feeding at the capilliary feeders; the food given at this point was devoid of scent. Different essences were used on the food and the bodies of the bees in this group. Both groups of bees were released simultaneously after being fully fed, and they returned to the hive.

Empty vessels were placed at distances of 30-40 cm from the feeding apparatus and these vessels were scented with the appropriate odor, i.e., at the first feeding point they were treated with the "food scent" and at the second point with the "body scent". For each experiment a new colony of bees was used. Except for the features described above, the experiments at the second series were carried out in a similar manner to the first.

At both points, counts were made of the bees flying to the scented vessels. Only those bees which extended their tongues toward the source of the olfactory stimulus were enumerated. The experiments were carried out with 4 repeats, using the odors described above on a previous page. Each experiment was performed in a fresh place using a new group of forager bees.

In contrast to the first series of experiments, the second series was carried out under much less favorable

conditions; despite this, the number of recruits was extremely high, so much so that at first they were found sitting about in considerable numbers around the "reserve collecting point". We planned to observe the recruitive activity of the marked bees over a period of half an hour, but because of unfavorable weather conditions this period had to be extended. The results of the experiment are given in Table 2.

As may seen from this table, the results of the second series (although gained in a slightly different way) fully confirm those of the first series in emphasizing the dominant role of the "body scent" in recruiting novice bees to food-collecting activity.

DISCUSSION

In the first series of experiments forager bees brought into the hive 2 scents: the first on the body, the second in the crop. In the second series of experiments 2 groups of bees were formed. The first carried scent into the hive only on their bodies, the second only within their crops. Despite the fact that in the first series of experiments great care was taken to ensure that there would be no mingling of the 2 scents (by using automatic feeders), nevertheless the possibility of some mingling of the body scent with that of the crop scent could not be completely excluded.

In 1950, K. Frisch came to the conclusion that at short distances from the hive (exact distances not known) the "body scent" and the "food scent" had equal significance from the point of view of recruitment value, whereas at greater distances than 800 m from the hive, the scent derived from flowers was lost from the bodies of forager bees together with its recruitive value.

Our results show that the "body scent" is twice as effective as the "food scent" for recruitive purpose, both at short distances (100m) from the hive and also at distances above 800 m (1000 m).

The discrepancies between Frisch's results and our own can be explained as follows: Frisch used the natural perfumes of ornamental flowers, viz., cyclamen and phlox, whereas in our experiments much more powerful concentrations of scent were applied both to the bodies of the bees and their food; this faciliatated the retention of the odor over longer periods of time.

We have, therefore, established that the scent carried into the hive on the bodies of forager bees has a higher recruitive significance than that carried on the food in the crop.

This conclusion is of great practical importance in relation to the possibility of directing the flight of honeybees toward economic plants in order to bring about their pollination by means of artificially produced flower scents placed on the bodies of forager bees.

SUMMARY

The comparative significance of two ways of food scent transfer into the hive (on the body of foraging bees and in the crop with food) for the recruiting activity of bees has been investigated.

The experimental separation of the food scent from the scent of the hairs of the forager's body was undertaken with the purpose of estimation of their recruitive significance.

In the first series of experiments different scents have been imparted to the body of foragers and to the food.

In the second series of experiments there were two groups consisting of equal number of bees; the bees of the first group carried the food scent to the hive only on their body, while the bees of the second group brought this scent only in their crop.

The relative significance of the two different ways of food scent introduction into the hive was estimated from the ratio of the numbers of new foraging bees recruited by means of each of these ways.

In both series the artificial communication of the food scent to the foragers' body resulted in very high recruitive significance of scent brought on the body; the number of bees recruited anew was twice that recruited by food scent brought in the crop.

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ADAPTIVE FEATURES IN THE STRUCTURE OF FEMALE GONADS IN INSECTS

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It is well known that the ovary in insects consists of separate egg tubes (ovarioles) which may vary in number within wide limits both in different systematic groups and in different instances within the same species. It is also known that the number of egg chambers which make up a single ovariole is very different in different species of insects. The question of the number of ovarioles, the number of egg chambers, and the factors which determine the regularity of their development has been repeatedly investigated in various insect families and orders and is discussed in the literature. However, I am not aware of any investigations which examine the problem of the number of ovarioles and egg chambers in a comparative manner throughout the entire class as a whole. There is only V. A. Dogel's endeavor (1954 : 206) to use the quantitiative variations in the number of ovarioles in insects as one of the examples of oligomerization of homologous organs. It seems to me that a survey of the problem as a whole would enable one to detect some general characteristics of adaptive evolution in the structure of the female gonads in insects. The present paper is primarily based on an analysis of literature sources, including some published earlier by the author, and only to a slight extent on previously unknown investigations.

The gonads of insects are formed as independent rudiments in the process of individual development during the early stages of embryogenesis. Cellular elements of double origin contribute to their formation: the sex cells themselves – the oogonia and oocytes, and also the nurse cells, which differentiate from the germ tract, which in many species of insects becomes separated as early as the period of cleavage. The follicular epithelium and the connective tissue membrane of the gonad develop from the inner sheath of the mesoderm and come into contact with the primary sex cells during segmentation of the mesoderm. Early differentiation of the germ tract is found especially frequently in various Diptera (Mechnikov, 1865; Kovalevskii, 1886; Ritter, 1890; Kahle, 1908). By irradiation of the polar plasm in Drosophila eggs at the beginning of cleavage, ovarioles devoid of sex cells and nurse cells developed (Geigy, 1931; Geigy and Aboim, 1944).*

In other orders differentiation of the germ tract during cleavage is observed in the Chrysomelidae (Hegner, 1908; Haget, 1953; et al.) and in some parasitic Hymenoptera (Hegner, 1915; Silvestri, 1915; Ivanova-Kazas, 1952). Earlier differentiation of the germ tract is not observed; the primary sex cells may be distinguished from the general mass of cells during the formation of the primitive streak or during its segmentation (Mija, 1952; Mukerji and Banerjee, 1952).

Seidel (1924) described a metameric movement of primary sex cells into the coelomic sacs of the first seven abdominal segments in Pyrrhocoris apterus L., while after the disappearance of the coelomic sacs the germ rudiments became concentrated in the second and third abdominal segments. A segmental arrangement of the primary sex cells during the germinal macula stage is also observed in the development of the silverfish Lepisma saccharinum L.; during closure of the tergites this segmental arrangement is distinctly seen in this species in the

*At the same time, the conception of the pole cells as only germ rudiments must now be reexamined, since in Drosophila some of them enter into the composition of the embryonic midgut (Poulson, 1947).

second to sixth abdominal coelomic sacs (Heymons, 1897; Sharov, 1953). In the lepismatids this initial location in five segments is preserved during almost all of postembryonic development such that only after the ninth molt, as a result of the reduction of the paired exit ducts, is ovarian metamerism lost. Each rudiment gives rise to one ovariole; five ovarioles are preserved in each ovary. This number of ovarioles is also characteristic of other genera of the Lepismatidae – Lepisma, Ctenolepisma, Lepismina, Nicolettia, Petrobius (Denis, 1949). In another family of Thysanura, in the genus Machilis, the close relationship of the ovarioles with the individual segments is lost, but their number (7) in each ovary corresponds with the number of developing metameric rudiments (Heymons, 1906). In the genus Japyx of the order Diplura there is one pair of ovarioles in each of the first seven abdominal segments in the adult state. At the same time in another genus, Campodea, segmentation of ovarian structure is completely lost; this is also characteristic of various Myriapoda. Among the Thysanura the primary segmental structure is also preserved in the testes. In adult Machilis there are three pairs of testes, in Lepisma three pairs, in Ctenolepisma seven pairs, and in Lepismina two. From the very beginning of development in male Lepisma only three pairs of testes are laid down within the limits of the third and fourth, fourth and fifth, and fifth and sixth segments (Sharov, 1953).

Gonad structure in the form of seven pairs of segmentally arranged ovarioles or testes must therefore be considered as the primitive one. Among the winged insects this number is most frequently preserved in the order Heteroptera. In the majority of families of true bugs (Cydnidae, Pentatomidae, Coreidae, Lygaeidae, Pyrrhocoridae, Reduviidae, Triatomidae, Nabidae, Miridae, Notenectidae, Corixidae) there is a preponderance of species with seven ovarioles in each ovary or seven pairs of testes. In other species of Hemiptera this number is reduced, with the reduction affecting the testes more frequently than the ovaries (Woodward, 1950). Dogel' (1954) considers it possible to admit eight ovarioles in the primitive state (in the prototype ovary) corresponding to the first eight abdominal segments on the basis of the assumption that they may be capable of developing in all the segments which lie before the gonopore. However, neither in embryonic development nor in the Japygidae and Thysanura, which have preserved the most primitive gonad structure, do eight pairs of germ rudiments develop; no more than seven are ever formed. Furthermore the gonadal opening (ovipore) is situated on the ninth segment only in the Lepidoptera and Coleoptera, while in all other orders it lies on the eighth and in the Lepidoptera there is a second – copulatory – reproductive opening on the eighth segment. Corresponding with the seven segments lying before the reproductive opening the rudiments of seven pairs of gonads may develop.

In most orders of winged insects the number of ovarioles in the ovaries and the number of sperm tubes in the testes are secondarily modified; their numbers may be reduced, the number of gonadal rudiments being reduced from the very beginning with a loss of the segmental nature of their arrangement (the process of oligomerization), or, conversely, the number of ovarioles may increase, sometimes considerably (the process of polymerization). An ovary with a secondarily augmented number of ovarioles may during the process of ontogeny or phylogeny secondarily undergo a process of oligomerization.

Within the confines of an entire order the most constant single number of ovarioles is maintained in the Lepidoptera, where it is four in each ovary. The only known exceptionsare several species of the Incurvariidae in which the number of ovarioles increase considerably: in Nemotois scabiosella Scop. there are 12-20 ovarioles, in Tegeticula alba L. (the Yucca symbiont) there are 30-36 (Bourgogne, 1951). In the Coleoptera considerable oligomerization is frequently observed; many species examined possessonly two ovarioles in each ovary, for instance Ips typographus L. L. (Merker and Wild, 1954), Ernobius mollis L. (Gardiner, 1953), Chrysomela varians L. (Rethfeld, 1924), Polydrosus mollis L. Strom (Lenkowa, 1949), and others. At the same time in the Lampyridae and Meloidae the ovarioles are numerous. In species of Staphylinidae also the number of ovarioles may reach 12 in each ovary (Jeannel, 1949).

In the Hymenoptera Aculeata only three ovarioles are developed in various species of Scoliidae, Mutillidae, Vespidae, Pompilidae, and Sphegidae; there are three to four ovarioles in the Apoidea. Exceptions are seen only in the social Hymenoptera (ants, honeybee), in which the number of ovarioles vary according to cast, and also in some parasitoids.

In the Diptera many ovarioles develop in each ovary, the number depending on the food conditions. In several parasitic species, however, such as Melophagus ovinus L. (Hippoboscidae) and Nycterebiidae, their number becomes secondarily reduced.

Polymerization in ovariole number also exists in many Polyneoptera. Among the grasshoppers there are

TABLE

Number of Ovarioles in Calliphora erythrocephala Meig. (compiled from the data of I. I. Ezhikov)

Number of ovarioles	Length of pupa			
	6.1–7.0 mm	7.1–8.0 mm	8.1–9.0 mm	9.1–10.0 mm
31–70	4	8	–	–
71–110	–	10	20	4
111–150	–	–	3	8
151–190	–	–	–	2
191–230	–	–	–	1

species with few ovarioles – four to five in each ovary (species of Stenobothrus, Euthystira, Chorthippus – and species where their number has been increased to 10 - 13 (species of Chrysochraon, Psophus, Mecostethus, Omocestus, Rubtsov, 1934; Waloff, 1954). An increased number of ovarioles is also characteristic of the Phasmatodia: 23 – 26 in Carausius morousu L., 12 - 14 in Sipyloidea sipylus W, and of the Blattoidea: 16 – 23 ovarioles in species of Blatta, Periplaneta, Epilampra, Panchlora, and Blabera (Hagan, 1941).

Thus, the number of ovarioles in different species of insects varies within wide limits. It may scarcely be doubted that when the number of ovarioles is reduced (oligomerization) each of them is homologous to that of the prototype with seven ovarioles. The formation of the germ rudiments in certain segments fall off and the number of ovarioles correspondingly diminishes. It is more difficult to establish the homology of the ovarioles with those of the prototype when their number has increased several times (polymerization) and all traces of the original correspondence of a pair of ovarioles with one of the abdominal segments has been lost. A reliable criterion would be provided by a thorough analysis of the process of formation of this type of ovary during embryogenesis, but this has not been sufficiently studied.

Actually, on the basis of some old investigations on cockroach development (Heymons, 1892) one may suppose that the formation of the primary sex cells does not occur all at once: they begin to differentiate from the mesoderm soon after it is laid down and their formation continues right up to the development of the coelomic sacs. At the same time, in Melanoplus differentialis Th. (Nelsen, 1934) all the primary sex cells apparently arise simultaneously with the formation of the mesoderm. These data only enable us to state that from the moment of division of the primary sex cells and the formation of oogonia the ovary immediately begins to develop as a multiple structure with a large number of future ovarioles.

Also taking into account the fact that the morphological processes which unfold during the individual development of each separate ovariole, one may obviously homologize the ovarioles of one type of ovary with those of another and approach the analysis of their development using similar criteria.

The processes of increase or decrease in number of ovarioles took place during phylogeny in an undoubtedly independent and parallel manner in various orders and families of insects. The number of follicles thereby evolved to a certain extent in inverse proportion to the number of ovarioles: the fewer the ovarioles, the more follicles within them, as a rule. This is easily seen when comparing the ovaries of Lepidoptera and Coleoptera Polyphaga with those of orthopteroid insects or flies. This rule is clearly seen only among those groups in which the formation of new follicles is finished by the postembryonic stages of development in connection with the curtailment of oogonial division (Shteinberg, 1938). In insects with telotrophic ovaries, such as the Heteroptera or the Coleoptera Adephaga, for instance, this correlation is difficult to see. However, even in polytrophic ovaries there may be only a few follicles with few ovarioles, as is known for many Hymenoptera Aculeata, for instance. The decrease of productivity in these cases is compensated for by care for the progeny, by assuring the presence of the necessary food for each hatching larva (Sphegidae, Mutillidae, Scoliidae, Apoidea, etc.).

A decrease in the number of ovarioles and consequently in fecundity is observed convergently in various orders upon transition to ovoviviparity or viviparity (Hagan, 1951). In Glossina tachinoides, as in other species of Glossinidae, there is only one ovariole on each side in the adult, such that the eggs become mature in the right and left ovarioles in turn and then enter the brood chamber. In Melophagus ovinus L. (Hippoboscidae) there are only two ovarioles in each ovary with a few oocytes only. In the Nycteribiidae the ovary is asymmetrical so that maturation of oocytes takes place individually and not simultaneously (Scott, 1917). In the viviparous Hemimerus (Dermaptera), a parasite of African rodents, there are 10 - 12 ovarioles in each ovary, of which the majority are nonfunctional; in another viviparous species of the same order, Arixenia sp., a parasite of bats on the Sunda Islands, only three ovarioles are left in the ovary. In the free-living and egg-laying earwigs of the genus Forficula, on the other hand, the ovarioles are numerous. A reduction in the number of ovarioles to six in each ovary occurs in the viviparous Hawaiian roach Diploptera dytiscoides Serk., in contrast with egg-laying species. Among the Heteroptera in the parasitic and viviparous Hesperoctenes fumarius Westw. only two pairs of ovarioles remain (Hagan, 1951).

All these instances of transition to ovoviviparity or viviparity in separate species of different orders clearly demonstrate the close connection which exists between development of eggs within a maternal brood chamber and the reduction in the number of ovarioles. On the other hand it is clear that this reduction became fixed relatively quickly in the descendants during the course of historical development, since it may be seen in species which have diverged comparatively little from their original typical ancestors in the order.

The converse process — an increase in the number of ovarioles in connection with changes in the environment — occurred no less easily and quickly. It may scarcely be doubted that the parasitic bumblebees of the genus Psithyrus evolved from the common bumblebees (Bombus) by adopting various morphological characteristics connected with a transition to a parasitic way of life (Popov, 1945).

By dissecting a considerable number of females and workers of various species of bumblebees collected in the Leningrad and Belgorod regions (Bombus derhamellus Kby., B. agrorum F., B. hortorum L., B. hypnorum L., B. silvarum L., B. lapidarius L., B. lucorum L., B. equestris F.), I determined that they always have a constant number of ovarioles which is the same in all species — four — regardless of whether the individual is a worker or queen. On the other hand, a dissection of females of three species of Psithyrus (as is well known, there are no workers in this parasitic genus) collected in the same localities showed that the number of ovarioles within them was two to three times greater than in Bombus and varied in different individuals and even in the right and left ovaries of the same individual. Thus, in six specimens of Psithyrus bohemicus Seidl. the following number of ovarioles were established: 12+11, 10+11, 10+10, 10+9, 9+9, 9+8; for P. rupestris F.: 11+10, 10+9, 10+9, 8+5; and for P. barbutellus Kby.: 11+11, 10+9. This increase in the number of ovarioles, possibly leading to an increase in fecundity in relation to that of female bumblebees, and evidently connected with the parasitic way of life, undoubtedly developed in an historically short period of time since the two genera, Psithyrus and Bombus, are very closely related and the separation of the parasitic bumblebees from the true bumblebees, occurred in the recent past.

A comparative investigation of various solitary bees collected in the Akmolinsk region showed that while in the free-living species of the genera Megachile, Dasypoda, Melitturga, and Halictus the number of ovarioles is three in each ovary and always constant, in some of the parasitic species it is increased and varies in different species and individuals of the same species and even in some specimens between the right and left ovary. Thus, in Nomada sp. the number of ovarioles was 5+5, 5+3, in Epeolus it was 7+6, 4+4, in Pasites it was 4+4, 3+3, 3+3, and in Sphecodes it was 3+3, and 3+3.

The transition to parasitism in various groups and genera of bees occurred independently and in a parallel manner (Popov, 1945). Even more interesting is the fact that in the parasites this led to a convergent increase in the number of ovarioles, probably as one of the principal ways of increasing fecundity.

Our attention is called to the fact, established by these dissections, that there is individual variation in the number of ovarioles in the polymerized ovary of the parasites. Although in the particular bees investigated the reason for the variability is not clear, this same phenomenon is widely distributed in other orders investigated. In species with the original number of ovarioles (7 pairs), as well as in species in which oligomerization has taken place, the number of these ovarioles characteristic of each species is not subject to individual variation in relation to environment conditions, for instance. Thus in the Lepidoptera, regardless of the

conditions under which the larvae feed, or of the quantity or quality of the food ingested, the number of ovarioles remains constant at four pairs. If the larva is deliberately starved the adult may emerge with incompletely developed ovaries in a more juvenile state of development with a reduced number of follicles (Shteinberg, 1935, 1938), but with a normal number of ovarioles. In the thoroughly investigated Eurygaster integriceps Put. a change in the number of ovarioles also does not occur with a worsening of feeding conditions.

At the same time, in insects with a polymerized number of ovarioles a worsening of feeding conditions in the larval phase leads to a reduction in the number of ovarioles. Thus, in Calliphora erythrocephala Meig. (Ezhikov, 1922) a good correlation is observed between the length of the pupa (which in turn depends on the quantity of larval food assimilated) and the number of ovarioles (see table).

It is evident that in this species the number of ovarioles may vary within wide limits (five times on comparing the extreme variants). In another fly, Sarcophaga coerulescens Zett., the number of ovarioles when the larvae are fully fed is 33 - 38. If the larvae are taken from their food 24 hours earlier,the adult flies emerging from these incompletely fed larvae have 22 - 27 ovarioles; if now the larvae are removed from their food 48 hours earlier,the number of ovarioles in the adult diminishes to 13 - 16 (Ezhikov, 1922).

In grasshoppers the number of ovarioles varies within wide limits. Thus, in the African Phymateus sp. their number is approximately 200 in each ovary (Waloff, 1954), while in Euthystira brachyptera Ocsk. there are only three in each (Rubtsov, 1934), and in Myrmeleotettix maculatus Thunb. there are also three or even two in each ovary in some specimens (Waloff, 1954). It may be observed that grasshoppers show individual variation in ovariole number both in species with a large number,and those with a limited number of ovarioles; for instance : in Stenobothrus lineatus Panz. the numerical relationship for both ovaries may be 4+4, 4+3, 3+3, or 2+2; in Chorthippus brunneus Thunb. 9+9, 8+8, 8+7, 7+7, 8+6, 7+6, 6+6, 6+5, or 5+5; in Oedipoda coerulescens L. and Oe. germanica Latr. 10+10, 10+12, or 12+12; and in Anacridium aegyptium L. 75+75, 68+66, or 56+56. If we compare the average number of ovarioles in two subfamilies of grasshoppers (Waloff, 1954), we see that in the tropical Catantopinae it is 27, while in the tropical Acridinae it is 11. Analogous numerical relationships in the same subfamilies also exist in both temperate and Mediterranean regions. If these numbers are arranged in a relative manner (in relation to the dimensions of the specimens in a given species), this relationship between the Catantopinae and Acridinae remains statistically demonstrable.

Since the Catantopinae with their larger number of ovarioles must apparently be considered a more primitive subfamily than the Acridinae(Truxalinae; Dirsh, 1956), it may be concluded that the older and more primitive type of ovarian structure in grasshoppers is one with a polymerized number of ovarioles and that their reduction in number in the more specialized subfamily Acridinae (Truxalinae) is a secondary process. Consequently, as a typical situation in grasshoppers there occurred an initial process of polymerization of ovarioles, as in all other orders of the orthopteroid complex, and then only secondarily, in the more specialized subfamily Acridinae, they once again became reduced even to an extreme limitation of their number (2+2). It is precisely because this reduction in number was not in the nature of a primary process (as it was, for instance, in the Lepidoptera) that traces of polymerization of the organ are preserved in the structure of the ovary. While in cases of primary oligomerization (Lepidoptera, Coleoptera, etc.) the number of ovarioles in a given species is strictly constant, in the grasshoppers even with a limitation in the number of ovarioles individual variation is observable both within the confines of a single locality (for instance, Chorthippus brunneus Thunb.) and in a geographical section (for instance, Ch. buguttulus L.; Waloff, 1954). Thus variation in ovariole number is peculiar to both grasshoppers and flies depending on conditions of existence. It has been shown (Albrecht, 1957) that after solitary rearing of Locusta migratorioides migratorioides R. and F. the number of ovarioles in the subsquent generation, constant from the moment of larval emergence, is somewhat higher than that in the parent individuals kept under group conditions. The physiological reasons for this interesting phenomenon are not yet clear.

It is well known that in the development of the honeybee, ovaries with a larger number of ovariole rudiments are formed in all larvae developing from fertilized eggs (Kozhevnikov, 1905). Subsequently however, it is only in the future queens, in connection with the special nature of the food that they receive that the ovarioles develop fully to their number of 180 - 190; the ovaries function successfully for several years with several mature eggs entering the oviduct daily from each ovariole. In the worker bees, on the other hand, which have not received a full amount of royal jelly, most of the ovarioles degenerate before pupation in relation to a reduction in the activity of the corpora allata (Lukoschus, 1956). The number of ovarioles in the emerging worker bees varies from 1 to 12 and from the right ovary to the left (Kozhevnikov, 1905) thus preserving in some of the

individuals the capacity to form mature, unfertilized eggs. In any case, in the honeybee also, as in the flies, the number of developing ovarioles depends on the nutritional conditions of the larva.

Therefore, both in individual species or genera (Psithyrus, Apis) and in larger systematic groups (Muscidae, Acridoidea) the polymerized ovary with its greater or secondarily reduced (Acridinae) number of ovarioles reacts to a deterioration in feeding conditions by an incomplete development of some of the ovarioles. In this reaction it is impossible not to see adaptive features, since if the insufficient food supply were evenly distributed among all the developing ovarioles it would not be enough even for the maturation of individual oocytes. With the incomplete development of some ovarioles, the limited amount of foodstuffs present in the haemolymph is distributed only among the remaining ovarioles and thus a certain, but diminished, fecundity is assured.

It is of great interest that in insects with oligomerized ovaries a similar adaptive reaction is achieved by an entirely different physiological process – a reduction in the number of oocytes maturing in each ovariole. Thus, in the Lepidoptera this takes place, on the one hand, through a limitation of oogonial division (Shteinberg, 1938) which is then reflected in a reduction of the number of maturing oocytes and of the formation around them of follicular epithelial capsules. In those species of moths which emerge with fully or almost fully mature ovaries and which do not feed in the imaginal phase, this process is evidently fundamental, since through partial starvation of the larva and a consequent reduction in the weight of the pupa their fecundity is correspondingly lowered (Skoblo, 1935; Kozhanchikov, 1947, et al.). On the other hand, with optimal feeding conditions in the larval stage, but with unfavorable conditions for pupal development, fecundity is also reduced, so that unfavorable energy metabolism may be reflected in ovarian development (Kozhanchikov, 1935). Changes in the ovaries which lead to reduction in fecundity have not been very clearly revealed; they amount to a degeneration in the oocytes at the beginning of vitellogenesis with a consequent atresia to the extent that supplementary adult feeding does not restore the necessary intake of nutritive material. For this reason in Loxostege sticticalis L., for instance, if imaginal feeding remains inadequate a completely sterile female may result (Shteinberg, 1935).

The mosquitoes apparently represent the only group of insects in which degeneration enters into the normal sexual cycle in spite of the fact that their ovaries consist of numerous ovarioles. In Anopheles maculipennis messeae Fall. a portion of the egg chamber undergoes degeneration and aborts even after normal feeding. With each subsequent gonotrophic cycle the number of mature oocytes become less: 88% in the first cycle, 65% in the fifth, 26.7% in the tenth (Detinova, 1949). With an insufficient share of ingested blood a degeneration begins in all the egg chambers of the following cycle, and not a single oocyte matures; this, according to Detinova (1953), is directly associated with an insufficient stretching of the gut and a consequent absence of the necessary impulses to the corpora allata. In Culex pipiens pallens Coq. a large scale degeneration of the oocytes is also observed upon digestion of human blood (Hosoi, 1954). Hence a considerable variability in the number of ovarioles is characteristic of the ovary of mosquitoes as it is of all polymerized ovaries; in this case it had a primarily seasonal character: more ovarioles develop in spring and summer females than in autumn ones.* When Anopheles maculipennis Mg. larvae are incompletely fed, an average of 70 ovarioles develops in each ovary; when feeding is not limited, 200 develop; in Aëdes (Stegomyia) fasciate the corresponding figures are 46 and 72 (Weidling, 1929).

Thus the structure and function of the gonads and, consequently, fecundity are controlled both in the larval and adult stages in mosquitoes; this is probably associated with the general and to a large extent independent adaptive evolution of mosquitoes in the two stages (Monchadskii, 1937).

Maturation of oocytes in the follicles does not occur simultaneously. In Lepidoptera which feed in the adult stage it was shown (Shteinberg, 1938) that this depends not only on differences in the timing of the beginning of differentiation from the terminal chamber, but also on a difference in the absolute rate of their growth, which diminishes from the proximal to the distal end of the ovariole. This peculiarity in the growth of the gonad is undoubtedly adaptive in character, since a limitation of imaginal food brings about an accumulation of food material primarily in the more mature oocytes and insures their maturation. This same physiological adaptation occurs in even more distinct form in other bloodsucking Diptera: the blood meal ingested after one feeding is expended for the growth of only one proximally situated maturating oocyte in each ovariole; the

*Seasonal differences in the number of ovarioles also exist, according to my observations, in different generations of plant feeding gall wasps.

blood is taken in a quantity which is strictly necessary for the maturation of only these egg cells. This specialized adaptive reaction, described for mosquitoes, sandflies (Glukhova, 1958), tabanids (Olsuf'ev, 1940), and other bloodsucking forms (the so-called "gonotrophic harmony"), evolved without doubt from the more general sort of gonad growth regulation studied in the Lepidoptera (Shteinberg, 1938). The sequence of gonotrophic cycles thus arising and the corresponding apportionment of oviposition are also known in other groups of insects (Mikhailova, 1955). It is striking that while in Anopheles an inadequate blood meal is reflectedin an inability of oocytes in any ovariole to develop, in sandflies, for instance, some of the oocytes nevertheless mature under these conditions (Dolmatova, 1942); there occurs a sort of supplementary redistribution of the blood taken into the organism; this Detinova (1953) has justly considered an improved regulation.

Therefore, the regulatory aspects of the structure and function of the female gonads in insects may be of a diverse character:

1. The number of ovarioles formed may vary from the very beginning depending on the conditions of development in the preceding generation, — gregarious locusts (Albrecht, 1957).

2. The ovarioles formed may be more or less constant in number, but under unfavorable conditions during the larval phase (malnutrition) some of them do not mature, — insects with polymerized ovaries (honeybee, flies, mosquitoes, grasshoppers) and apparently also those with secondarily oligomerized ovaries (Acridinae).

3. The number of ovarioles may be formed at a constant seven pairs or less; their number is not subject to change during the course of postembryonic development, but the number of oocytes being formed and maturing in each ovariole varies according to developmental factors in the larval, pupal, or imaginal phases, — Lepidoptera, Hymenoptera Aculeata. Underdevelopment of oocytes is associated with their degeneration. The Culicinae combine characteristics of both the second and the third group.

4. A supplementary regulatory feature is provided by varying the rate of growth of oocytes which are longitudinally arranged in each ovariole; this is associated with an unequal distribution of the food material entering the organism, — Lepidoptera, the "gonotrophic harmony" of bloodsucking Diptera, and expressed in a more adaptive form in the heleids and Phlebotomus.

All these adaptive features in the structure and function of the gonads are directed toward securing optimal fecundity at the onset of some specific unfavorable condition for existence; fecundity is lowered but is preserved as much as possible. On the other hand, the gonads of insects also have the capacity easily to increase the reproductive potential by increasing the number of ovarioles; this is clearly seen when various groups adopt a parasitic way of life.

SUMMARY

It is well known that the number of ovarioles varies within wide ranges in insects.

7 ovarioles are considered to be the most primitive number; this conclusion results from analysis of ovary structure in Thysanura, Japygidae and from data on their ontogenesis as well. Such a primitive condition among contemporary insects is most characteristic of Heteroptera. In the majority of insects this number either is reduced (oligomerized ovary) or increased, sometimes quite considerably (polymerized ovary). The former is characterized by a constant number of ovarioles, the second by great individual variability in the number of ovarioles, depending on the conditions of existence or inheritance, in particular between the right and left ovary. Under unfavorable conditions of development, expecially with insufficient nutrition in a polymerized ovary, some ovarioles do not develop and the fecundity decreases. correspondingly. In an oligomerized ovary when nutrition grows worse the number of ovarioles does not decrease but the number of follicles becomes less in the subsequent generation of oocytes; sometimes this leads to complete sterility. The Culicinae provide the single example in which the regulation of fecundity is completed during the larval stage because of the number of developing ovarioles, and during the imaginal one because of degeneration when some oocytes do not receive sufficient nutrition. The ability of differently situated oocytes for uneven growth is an additional peculiarity regulating the function of gonads; the rate of growth of oocytes proximally situated is greater than that of those situated distally. In the most specialized forms this peculiarity is expressed in bloodsucking Diptera in which the maturity of one oocyte in every ovariole (gonotrophic harmony) is brought about by every portion of blood ingested. It is shown in this paper that in insects not only a decrease in the number of ovarioles but the reverse process — an increase — takes place. This phenomenon is observed in allied species of Apoidea of which one is

a free living species and the other is its parasite, for instance, in the pairs: Bombus-Psithyrus, Andrena-Nomada and others. In all insects adopting parasitization of Apoidea polyphyletically the number of ovarioles increases convergently in relation with the host.

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NESTING OF BUMBLEBEES IN THE KOMI ASSR

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The most complete data on the nesting of bumblebees may be obtained when observations are carried out upon the founding queens at the time of nest formation just after hibernation. In bumblebees which nest on the ground, the foundation of the colony may be successfully observed under natural conditions. By carefully removing the construction material on the upper part of the nest for three or four minutes, one may determine the presence of eggs and count the number of sealed and empty cells. Later on, when the colony becomes large, it is more convenient to observe the nest in the laboratory. The nest is transported in the evening after the insects have terminated flight. Nests above ground are carefully covered with a piece of gauze (35 x 35 cm) with its free edges pressed into the earth with the fingers. With a long knife, the nest, together with some soil, is carved out in the form of a cone and tied around with string. Underground nests are dug out with a sharp spade (the entrance opening is plugged with a wad of cotton or paper). In order to determine the location of nests, tapping is first carried out. When light blows are made over the nest with a stick, the insects respond with a loud buzzing. Boxes or baskets are used for transporting the bees. In the laboratory the procedure begins with the opening of a small hole in the side of the nest. The emerging bees are collected into two or three covered half-liter flasks. After the nest has been thoroughly examined, the bottom, on which the comb is laid, and the roof of the nest must be reconstructed. The bumblebees, which by this time have been collected into a single flask, are quickly spilled out into the cup-shaped floor, covered by the saucer-shaped roof, and tied around with gauze. Early in the morning the nests are placed in suitable locations near clover seed beds. The work in the field and in the laboratory was carried out by two people.

1. The Nesting of Bumblebees

In the Komi ASSR the flight of the females from the overwintering places occurs at the end of April and the beginning of May. Snow is still present in the forests and the air temperature sometimes goes down to $-5°$. At this time the bees primarily visit willow.

The prenesting period of the female is somewhat prolonged. It lasts up to $1\frac{1}{2}$ months, apparently because of an insufficiency of flowering plants. This assumption is corroborated by the fact that nest construction coincides with the time of greatest flowering of nectariferous plants (the second half of June).

Only under these conditions may the founding queen secure a sufficient quantity of varied food and thus preserve her full value. The nests are most frequently constructed in areas with a rich and varied flora. Meadows which are poor in nectariferous plants are sparsely populated. Thus, of the 128 nests (Table1) we studied in 1951 and 1952, 52 (40.7%) were listed for mixed-grass meadows, 29 (22.7%) for short-grass meadows, and only 13 (10.2%) for ranunculous and gramineous meadows. Boundaries of fields, fields, and plowed lands, which most frequently come under human influence during the growth of the vegetation, are infrequently inhabited by bumblebees. Only 11 nests (8.5%) were found in these biotopes. Many species of bumblebees (Bombus hortorum L., B. equestris F., B. hypnorum L., B. derhamellus rossicus Skor., B. distinguendus F. Mor., and B. lucorum L.) sometimes live near human habitations (yards, vegetable gardens) or in man-made structures (baths, barns, cellars, haylofts, attics) (23 nests, 17.9%).

B. equestris, B. agrorum, and B. derhamellus rossicus are known to nest above ground, B. lucorum, B. soroensis laetus, and B. sicheli below ground, and B. distinguendus and B. hortorum both above and below ground.

TABLE 1

Biotopes of Bumblebee Nesting Sites

Species of bumblebee	Period of observation 1950—1951	Number of nests observed	Nesting sites and number of nests														
			mixed-grass meadows in ravines	short-grass forest meadows	man-made structures	ranunculous, graminous meadows	truck-farms	boundaries	fields	plowed fallow	yards	on the ground	in the ground	in high, dry places	in low, damp places	in low, dry places
B. equestris F.	5 VII—24 VIII	38	23	3	—	4	3	2	1	1	1	38	—	31	6	1
B. hortorum L.	6 VII—27 VIII	28	4	5	13	2	2	1	—	1	—	24	4	25	3	—
B. agrorum F.	16 VII— 6 VIII	20*	10	8	—	2	—	—	—	—	—	20	—	10	7	2
B. distinguendus F. Mor.	16 VII—18 VIII	20	6	5	—	4	1	1	3	—	—	11	9	11	7	2
B. derhamellus rossicus Skor.	8 VII—10 VIII	5	2	2	—	—	1	—	—	—	—	5	—	5	—	—
B. lucorum L.	22 VII—16 VIII	2	—	—	—	—	1	—	—	1	—	—	2	2	—	—
B. soroensis laetus Schmied.	3 VIII	1	—	1	—	—	—	—	—	—	—	—	1	1	—	—
B. sicheli Rad.	6 VIII	1	—	1	—	—	—	—	—	—	—	—	1	1	—	—
Nests with mixed species																
♀- Founding *B. agrorum* F. + ♀- interloper *B. equestris* F.	6 VII— 6 VIII	10	6	3	—	1	—	—	—	—	—	10	—	5	4	1
♀- Founding *B. derhamellus rossicus* Skor. + ♀- interloper *B. equestris* F.	6 VII— 6 VIII	2	1	1	—	—	—	—	—	—	—	2	—	2	—	—
♀- Founding *B. hypnorum* L. + ♀ interloper *B. hortorum* L.	26 VIII	1	—	—	1	—	—	—	—	—	—	1	—	1	—	—
Total		128	52	29	14	13	8	4	4	3	1	111	17	94	27	6
Same %		—	40.7	22.7	10.9	10.2	6.2	3.1	3.1	2.3	0.8	86.7	13.3	74.0	21.3	4.7

* List of localities omitted.

TABLE 2

Nest Construction Materials

Species of bumblebee	number of nests observed	Construction materials										Nidification					
		Sphagnum	cereal leaves and stems	plant remains	Sphagnum + M. + cereal leaves and stems	Sphagnum + + Mnium	Sphagnum + Mnium + cereal leaves and stems	Sphagnum + plant fragments	straws + other coarse plant fragments	tow + wool + + paper scraps	other types of materials	in animal hides	in wool	in fur	in straw	in hay	in flax
B. equestris F.	38	17	7	2	4	3	2	1	—	—	2	—	—	—	—	—	—
B. hortorum L.	28*	3	7	3	—	—	—	—	—	1	1	3	2	1	2	1	2
B. agrorum F.	20*	14	—	—	2	2	—	—	—	—	1	—	—	—	—	—	—
B. distinguendus F. Mor.	20	5	3	7	1	—	—	1	2	—	1	—	—	—	—	—	—
B. derhamellus rossicus Skor.	5	3	—	—	1	—	—	—	—	—	1	—	—	—	—	—	—
B. lucorum L.	2	—	—	2	—	—	—	—	—	—	—	—	—	—	—	—	—
B. soröensis laetus Schmied.	1	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
B. sicheli Rad.	1	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Nests with mixed species																	
♀ Founding *B. agrorum* F. + ♀ interloper *B. equestris* F.	10	4	1	—	—	—	3	1	—	—	1	—	—	—	—	—	—
♀ Founding *B. derhamellus rossicus* + ♀ interloper *B. equestris* F.	2	—	2	—	—	—	—	—	—	—	—	—	—	—	—	—	—
♀ Founding *B. hypnorum* L. + ♀ interloper *B. hortorum* L.	1	—	—	—	—	—	—	—	—	—	—	1	—	—	—	—	—
Total	125	48	20	14	8	5	5	3	2	1	7	4	2	1	2	1	2
Same %	—	38.4	16.0	11.2	6.4	4.0	4.0	—	—	—	20.0						

*Construction materials for two nests of B. hortorum and one of B. agrorum are not listed.

TABLE 3

Growth of the Bumblebee Colonies from July to September 1951

Species of bumblebee	Dates on which nests were found still empty	Times when sealed broods were recorded		Average number of bees from						Maximum number of eggs laid by females during summer
		1st egg clutch	2nd egg clutch	5—15 VII		16—31 VII		1—15 VIII		
B. equestris F.	5 VII	5— 8 VII	14 VII	3	7.0	13	16	?	48	?
B. hortorum L.	6 VII	8—14 VII	19 VII	11		20		44		165
B. agrorum F.	11 VII	11 VII	14 VII	6		19		58		108
B. distinguendus F. Mor.	—	16 VII	24 VII	—		14		42		102
B. lucorum L.	—	—	—	79		?		263		364

TABLE 4

Nest Symbionts of Bumblebees

Species of bumblebee	Nests with mixed species					
	Parasiticus fucorum Geer.	larvae of the fly Brachycoma sp.	larvae of the fly *Fannia* sp.	larvae of the flies *Sarcophagidae*	larvae of the beetle *Antherophagus* sp.	caterpillar of *Aphomia sociella* L.
B. equestris F.	24.3	27.0	2.7	—	2.7	2.7
B. hortorum L.	30.8	30.8	11.5	11.5	11.5	3.8
B. agrorum F.	52.6	42.1	21.0	—	10.5	—
B. distinguendus F. Mor.	57.9	84.2	10.5	—	21.0	—
B. derhamellus rossicus Skor.	100.0	80.0	20.0	—	—	—
Larvae of the fly Brachycoma sp.	46.1	53.9	7.7	—	5.5	—

According to Skorikov (1927) only one inhabitant of the northern forest, B. hypnorum, constructs its nests above ground only, all the other species nest both above and below ground.

Of all the nests examined 111 (86.7%) were constructed above ground and only 17 (13.3%) below. The reason for this is the high level of the water table. Bumblebees prefer elevated and dry locations for nesting (94 nests, 74.0%), or low and damp ones (27 nests, 21.3%), or low and dry ones (6 nests, 4.7%). Only in B. agrorum and B. distinguendus are both elevated and dry (respectively 10, 52.6%, and 11 nests, 55.0%) and low and damp or dry sites (respectively 9, 47.4%, and 9 nests, 45.0%) used approximately to the same extent for nesting.

Above-ground nests are primarily built in depressions in or near mounds and underground ones in cavities in the soil or rodent burrows.

The most diverse construction materials are used in nest building (Table 2). More than one third of the nests are made of Sphagnum (38.4%). Some of them use leaves and stems of cereal grasses (16.0%), plant fragments (11.2%), Sphagnum plus cereal stems and leaves (6.4%), and more rarely Sphagnum plus Mnium (4.0%) and Sphagnum plus Mnium plus cereal leaves and stems (4.0%).

B. equestris constructs its nests primarily of Sphagnum (44.7%) or leaves and stems of grains (18.4%), B. agrorum almost exclusively of Sphagnum (73.7%), and B. distinguendus of plant fragments (35.0%) and Sphagnum (25.0%). The nests of B. hortorum are interesting in this respect. When it nests in or near man-made structures this species does not accumulate nesting material as long as the colony lives in sufficiently warm places, such as animal hides, wool, straw, hay, etc.

Using the data obtained when checking nests we have attempted, in an approximate manner, to give an estimate of the population dynamics of the bumblebees' colonies during the course of the summer period (Table 3). The census of the bees was carried out according to the number and size of the empty cells. The longevity of a single individual was provisionally set at 40 days.

The sealed brood from the first clutch of eggs was recorded from the 5th to the 16th of July, that from the second from July 14 to 24.

The first worker individuals were recorded on flowering plants earlier than they were in the nests (B. agrorum, July 5; B. equestris July 7; B. hortorum, July 9).

At the time when red clover was beginning to flower (July 10 - 15), there were but a few individuals in the nests of the bumblebees which play a major role in the pollination of this crop (B. hortorum, B. agrorum, B. distinguendus, and B. equestris). The number of bees in the nests reached a maximum only by the time of clover blossom fall in the second half of August. For instance, in 1951 the average numbers of these species were 7 on July 5 - 15, 16 on July 16 - 31, and 48 on August 1 - 15. These observations are supported by counts of pollinators on clover (Kupchikova, 1954). The interval between the times of maximum bumblebee numbers and maximum clover flowering is about 20 days. As a consequence natural pollinators cannot bring about the first half of the clover flowering period. During this time it is necessary to introduce honeybees to the clover seed beds.

The B. lucorum females are the most prolific. Their fecundity exceeds that of the queens of the other bumblebee species by two (B. hortorum) or three times (B. agrorum, B. distinguendus).

Skorikov (1922) mentioned that underground nests have a larger number of inhabitants. This statement was supported by our observations with regard to only one species – B. lucorum. In B. distinguendus and B. hortourum the number of individuals in a colony does not depend on the nesting site.

After the appearance of the first workers, flights by the founding queen from the nest become sharply curtailed. Thus, after 14 ten-minute counts near a nest, 80 flights by worker bees were recorded versus only 8 by the founding queen. Mel'nichenko and his co-workers (1949) pointed out that at this time the queen is occupied with breeding the colony and protecting the nest.

2. Symbionts in Bumblebee Nests

I take this opportunity to thank L. V. Arnol'di, A. A. Shtakel'berg, N. G. Bregetova, and L. S. Zimin for determining the bumblebee symbiont material which I collected.

The bumblebee nests contained the most varied symbionts; however, until the middle of July they were not infested.

The most widespread nest inhabitants were the mite Parasiticus fucorum Geer and the fly larva Brachycoma sp. (table 4).

In several nests the number of mites was so great that it proved impossible to count them. They were encountered both as adult forms (♀♀ and ♂♂) and as deutonymphs and protonymphs. They were more or less evenly distributed in the construction material. On the bumblebees and parasite bees Parasiticus fucorum was localized primarily in the region of the dorsum and petiole. On one bee female 163 mites were counted. B. distinguendus, B. derhamellus, and B. agrorum are infested by mites to a large extent.

The bee nests were 24.3 to 100% infested with larvae of the fly Brachycoma sp., which were concentrated primarily in the litter or the ground beneath the litter of the nests, sometimes to a depth of 2 - 3 cm. There is a basis for believing that they feed on honey and are commensals. Several nests contained 20 to 75 larvae. The oviposition period of Brachycoma sp. is greatly prolonged, lasting from about the middle of July to the end

of August. Nests of B. distinguendus were 84.2% infested by these symbionts, those of B. derhamellus 80.0%, those of mixed species 53.9%, and those of B. agrorum 42.1%.

Larvae of the fly Fannia sp. were fairly frequently encountered in bumblebee nests. The most infested nests were those of B. agrorum (21.0%) and B. derhamellus (20.0%). The Fannia larvae are very mobile. They occupy the litter and the roof of the nest, empty cells and those with bee larvae. The bee brood was destroyed in the cells, the walls of which were perforated. Evidently the fly larvae are predators feeding on the bumblebee brood.

The nests contained, in addition, larvae of beetles of the genus Antherophagus, which feed on waste matter rejected by the bees, and caterpillars of Aphomia sociella L., which feed on the wax of the comb.

The symbionts mentioned above were almost never present in B. hortorum nests found in man-made structures. Only a few nests contianed Parasiticus fucorum and larvae of Antherophagus sp. However, under artificial conditions B. hortorum nests were heavily infested with sarcophagid fly larvae. The box in which the bees were placed with the comb was covered with glass and a piece of cardboard. At first the cardboard and glass were removed for a few mintutes only in order that the bees could become gradually accustomed to the light. After six days the bees ceased to react to the light and worked normally in the open nest.

On August 10 our attention was drawn to everal bees which were breaking open a sealed cell. In this cell three larvae of sarcophagid flies were discovered with an empty bee larva skin. The same was repeated on August 14 – the bees opened 2 sealed cells; one of the parasite larvae was located inside a bee pupa. Toward August 17 the entire sealed brood which had pupated from August 5 to 15 was broken open by the bees. This sort of heavy infestation may be explained by the fact that the bee nest remained open, without glass, all day long.

The stimulus for the bees to open the sealed cells is apparently provided by the vibration of the cell by the fly larvae. The same situation occurs when the young bees emerge. The fully formed bee gnaws at the cell from the inside and the older bees from the outside. In either case the bees assist the emergence of organisms from the cell. It is interesting that when the nest contains parasite larvae the bees do not react in any way. All the above mentioned bumblebee symbionts are evidently passive inhabitants of the nest.

The most interesting cases of parasitism of bumblebees are those which involve insects from the same group of aculeate Hymenoptera.

It is well known that parasite bumblebees attack bumblebee nests; bumblebees of other species or even of the same species parasitize the nests of one another.

Mel'nichenko and co-workers (1949) were able directly to observe a repeated exchange of interloper queens in the same nest. Of 12 cases of aggression in only two did the interloper queen attack a queen of its own species. The interloper queens were most frequently females of B. equestris. Voveikov (1953) also mentions that B. equestris is seen to usurp other nests. We cannot agree with the author in not seeing in this sort of usurpation one of the ways in which parasitism may arise in the animal world.

Popov (1945) examined the various instances of parasitism in the aculeate Hymenoptera and indicated, following Taylor's scheme, the ways in which parasitism could arise in these insects. Interspecific obligatory and permanent parasitism, according to Popov, could arise, on the one hand, through intraspecific, or on the other hand, through interspecific temporary facultative parasitism. It seems to us that this hypothesis could not be better supported than by B. equestris. An analysis of the genus Radoszowskiana (Popov, 1955) also emphasizes the feasability of this means of establishing parasitism in aculeate Hymenoptera.

Mel'nichenko and co-workers (1949) consider the cases of attack by a queen on another of the same species as a negative evolutionary factor leading to the extinction of the species. It seems to us that this is not altogether so, since the evolution of the species does not cease in this case. Parasitism could lead to the formation of a new species which could develop no less succesfully, but in another direction. In all cases the process of speciation proceeds with the elimination of the old species. Divergence in the same species may proceed in different ways.

On examining nests of bumblebees we also observed instances of interspecific facultative parasitism, primarily by B. equestris. In 12 nests the interloper females were B. equestris while the founding quees were

B. agrorum (10 nests) and B. derhamellus (2 nests). All three species belong to the same subgenus Agrobombus. In one nest only, the interloper queen was B. hortorum and the founding queen B. hypnorum (Tables 1 and 2).

Parasitism by B. equestris of nests of B. agrorum and B. derhamellus does not appear to us to be accidental. It is expained by the similarity in nesting behavior of these species, all three species construct nests above ground, they use Sphagnum primarily as the construction material, or Sphagnum plus leaves and stems of grains, or the latter alone. B. hortorum and B. hypnorum also have much in common in their nesting habits: both species inhabit man-made structures and utilize ready-made construction material.

The parasite bumblebees Psithyrus bohemicus Seidl. (1 individual) with B. distinguendus, Psithyrus globocus Eversm. (1 individual) with B. equestris, and Psithyrus barbutellus Kby. (from 1 to 4 individuals) with B. hortorum, were also encountered.

When we kept bumblebees in the laboratory we were witness to the death of 4 queens (3 of B. hortorum and one of B. distinguendus) caused by Psithyrus bohemicus. Antagonistic relationships exist between the bumblebees and parasite bees. Our observations showed that similar relations exist between bumblebee individuals belonging to different species. The bees do not admit individuals of another species into the nest. Deliberate introduction or accidental entry of bees into a nest always ends in the expulsion or death of the individual of the other species. On the other hand, as we have already indicated above, nest symbionts in the form of larvae of flies, beetles, or moths do not undergo any persecution whatever at the hands of their bumblebee hosts. Evidently the instinct of self-preservation was modified during the process of evolution to respond to aggressive behavior from other organisms.

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HIBERNATION SITES OF ICHNEUMON FLIES (HYMENOPTERA, ICHNEUMONIDAE)

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Various authors have made references to hibernation sites of ichneumon flies (Kulagin, 1886; Berthoumieu, 1894 - 1896; Morley, 1903; Meyer, 1913; Pic, 1917, 1919; Bischott, 1927; Constantineanu, 1929; Smith, 1932; Clausen, 1940; Dinther, 1951). According to these data, the majority of overwintering ichneumons belong to the Ichneumoninae stenopneusticae (Hoplismenus, Chasmias, Ichneumon s. l., Exephanes, Neotypus, and Amblyteles). In addition, several species of Ichneumoninae cyclopneusticae, two species of Pimplinae, and also the wingless Cryptinae (Morley, 1903, with no indication of species) have been found in hibernation sites. A total of 102 species of Ichneumonidae are known to overwinter in the imaginal phase, according to the literature known to us, only the females having been found in the overwintering places.

The principal hibernating sites mentioned are spaces beneath the bark or in the wood of dead trees and in moss at the base of the trunks (cited by most authors), forest litter, spaces under stones (Bischoff, 1927), and bundles of dry grass (Clausen, 1940). Pic (1917) states that openings beneath bark and in wood are the most suitable for ichneumons, hibernation sites being located in moss only when there are no suitable shelters under bark and in wood. According to Pic's observations (1917), thick bark or large pieces of it which possess the best thermal insulating properties, are more readily inhabited by ichneumon flies than thin bark or small pieces. In general, ichneumons do not hibernate beneath small pieces of bark. Pic (1917) and Berthoumieu (1894-1896) maintain that ichneumons overwintering in fallen trees concentrate in the western and upper sides of the trunk, thereby avoiding dampness.

Several authors discuss some of the particulars of overwintering in several species. For instance, according to Constantineanu (1929), Hoplismena pica Wesm. and H. bispinatorius Thunb. avoid hibernating with other species while many species of the genus Ichneumon, on the other hand, frequently form heterogenous aggregations. Some species overwinter under bark (Chasmias lugens Grav.), while others escape deeper (Ichneumon quaesitorius L., Amblyteles camelinus Wesm., etc). There are species which overwinter both under bark and in wood (Protichneumon disparis Poda, Stenichneumon culpator Schrnk., A. binotatus Kriechb.). Stenodontus nasutus Wesm. is found only under moss. Very large aggregations--up to one hundred or more individuals--are characteristic of Ichneumon proletarius Wesm.

Our data on the overwintering of ichneumon flies was collected in 1952-1958 in the following locations of the Moscow and Kalinin regions: Kalinin region — Igumenki (Zavidovskii district); Moscow region — Verbilki (Taldomskii district), Pokrovka (Klinskii district), Berezki (Solnechnogorskii district), Popovkino (Volokolamskii district), Dorokhovo (Vereiskii district), Krekshino, Rassudovo (Narofominskii district), Los' (Mytishchinskii district), Ivanteevka (Pushkinskii district), Golytsino, Shkol'naya, Lutsino (Zvenigorodskii district), Faustovo (Vinogradovskii district), and Luzhki (Serpukhovskii district). In addition, data collected by V. T. Borovikova in Luzhki, Serpukhovskii district, in February and March, 1951, were used.

I take this opportunity to express my gratitude to G. A. Viktorov and Prof. E. S. Smirnov for general guidance and much practical help during the investigation.

We found the following members of the family Ichneumonidae in hibernations sites:[1]

Hoplismenus bispinatorius Thunb.	1	**I. memorator* Wesm.	180
H. luteus Grav.	3	**I. multipictus* Grav.	1
H. pica Wesm.	3	**I. primatorius* Först.	5
H. terrificus Wesm.	1	**I. quadrialbatus* Grav.	5
Chasmias lugens Grav.	7	**I. rufidens* Wesm.	5
Ch. motatorius F.	21	*I. subquadratus* Thoms.	1
**Ch. paludicola* Wesm.	1	*I. suspiciosus* Wesm.	2
**Stenichneumon calcatorius* Thunb.	3	*I. terminatorius* Grav.	2
**St. castaneus* Grav.	20	**I. tuberculipes* Wesm.	1
St. culpator Schrnk.	30	**Ichneumon* sp.[2]	4
St. militarius Thunb.	1	**Barichneumon* sp.[2]	1
**St. puerulus* Kriechb.	1	*Amblyteles crispatorius* L.	1
St. scutellator Grav.	28	**A. filatus* Tischb.	3
**Ichneumon batis* Holmgr.	1	*A. indocilis* Wesm.	21
I. bucculentus Wesm.	2	*A. quadriguttorius* Thunb.	2
**I. cessator* Müll.	1	**Phaeogenes stimilator* Grav.	1
I. confusorius Grav.	17	**Tyraeella* sp.[2]	7
**I. didymus* Wesm.	1	Subfamily. *Cryptinae*	
I. extensorius L.	175	**Coenocryptus striolatus* Thoms.	2
I. gracilentus Wesm.	108	**C. laticrus* Thoms.	1
I. gracilicornis Grav.	2	Subfamily. *Pimplinae*	
I. inquinatus Wesm.	3	**Epiurus ventricosa* Tschek.	1
**I. insidiosus* Wesm.	3	**E. vesicaria* Rtzb.	1
I. latrator F.	17	*Pimpla turionella* L. (nec auct.)	51
I. longeareolatus Thoms.	5	Subfamily. *Tryphoninae*	
I. mäklini Holmgr.	1	**Orthocentrus asper* Grav.	Total 620

A total of 1370 individuals of 50 ichneumon species were collected.

The General Characteristics of the Overwintering Shelters and the Distribution of Ichneumons within the Shelters

Nearly all the material was collected beneath the bark of trees and in wood. Only occasional individuals were found in other situations. For instance, not more than four ichneumons were found in moss: one individual each of I. extensorius and I. latrator and two of I. gracilicornis. Detailed searches in litter were not carried out, but both specimens of Coenocryptus striolatus were found on fallen leaves; they had evidently crawled out from under them, since this occurred during a sunny day in the beginning of November, that is, considerably later than the usual time for entering hibernation sites (see below). The search for overwintering ichneumons under stones and in dry grass was not succesful. Further analysis is devoted only to those overwintering sites which were in trees.

Ichneumons hibernate primarily under the bark of stumps and trunks of dead trees. In very old trees with fallen bark and partially destroyed wood the hibernation sites may be found in spaces in the wood. Live trees provide shelter in local dead areas where they form cracks and cavities.

Ichneumons hibernate more readily under the thick bark of pine than under the thinner bark of spruce (see below). However, even the thin bark of spruce and oak, even small pieces of it (1 dm^2 or smaller) are often used as hibernation sites for comparatively large groups of ichneumons (up to 20 or more specimens). It is only beneath the thin bark of dead birch that overwintering ichneumons are not found. The reason for this is apparently the fact that in those trunks the wood usually consists of fine, very dry wood dust and high humidity is evidently very important to ichneumons for hibernation to take its normal course. At any rate, much ice can always be found in their shelters. Kalabukhov (1956) has also emphasized the necessity for considerable humidity during the hibernation period in many insects.

[1] Species which are not cited in the literature known to the author are marked by asterisks. The number refer to the number of specimens found.
[2] Apparently new species.

TABLE 1

First Autumn Encounters of Ichneumons in Hibernation Sites

Date	Species found	Phenological observations
26 IX 1953	Amblyteles crispatorius	Lindens almost leafless, birches yellow; young birches and oaks partly green
19 IX 1954	I. gracilentus, I. molitorius, I. primatorius, St. castaneus, St. culpator.	Lindens yellowed; bilberry leaves falling
25 IX 1955	I. memorator	Slight leaf fall; shrubs green; Lampyris flashing
23 IX 1956	I. memorator	Slight leaf fall
21 IX 1957	I. extensorius, I. gracilentus, I. memorator, St. castaneus, St. puerulus, Chasmias motatorius, Orthocentrus asper	The same

TABLE 2

Last Autumn Encounters of Ichneumons outside Shelters

Date	Species	Collection sites	Weather	Phenological observations
9 X 1955	H. bispinatorius	On grass	Cloudy	End of leaf fall
7 X 1956	I. extensorius, I. gracilentus A. crispatorius	Near stump	Sunny	End of leaf fall
20 X 1957	I. extensorius	On stump		
9 X 1957	Coenocryptus striolatus	On litter		Leaf fall ended

In our opinion, ichneumons suffer much less from frosts. For instance, the majority of them undergo the winter perfectly well not only under thin bark, but even under small pieces of it (1 dm^2 or less in area) which are much above the snow level.

We know of only one case when ichneumons died of cold: two groups of P. turionella (of 10 and 40 individuals), overwintering under some small projecting pieces of bark over dead portions of a spruce trunk above the snow level, perished in toto after the frosts of January, 1956, when the temperatures sank to − 40°C and lower. However, some St. scutellator, overwintering under even more difficult conditions (in the same shelter, in a spot almost unprotected from the wind), lasted out the winter without a single loss.

TABLE 3

Last Spring Encounters of Ichneumons in Hibernation Sites

Date	Species found	Phenological observations
26 IV 1953	I. gracilentus, I. insidiosus, St. castaneus, St. culpator.	Sap flow in birch; hop clover and aspen past bloom; elder blossoming
2 V 1955	I. gracilentus, I. insidiosus	Much snow in spots; coltsfoot blossoming
2 V 1956	I. gracilentus, I. extensorius, I. confusorius, I. memorator, I. rufidens, St. castaneus, St. culpator	Sap flow in birch; pasque-flower, willow, anemone, daphne, etc. flowering
2-3 V 1958	Ch. lugens, Ch. motatorius, St. culpator, I. memorator, Ch. paludicola	Sap flow in birch; willow, hop clover, coltsfoot flowering

TABLE 4

First Spring Encounters of Ichneumons outside Shelters

Date	Species found	Collection localities	Phenological Observations
2 V 1953	A. trifasciatus Grav.	On flowering willow	Pasque-flower and willow flowering; sap flow in birch
2 V 1956	Ch. motatorius	In grass	Much snow in spots; coltsfoot blossoming

High winter temperatures or sharp alternations of warmth and cold are evidently much more dangerous for ichneumons. This may explain the fact that, especially in open areas, these insects most often overwinter on the north side of stumps and trunks, as close as possible to the soil (if it is not too damp, they may even be found in large numbers on the lower surface of fallen trees).

On the north side of a tree there is less sun, more epiphytic growth, the snow stays longer, and the temperature is maintained at a more constant and lower level. Thus, on March 23, 1953, when the air temperature was 9° C, under the bark of an aspen stump it was 15°C on the south side and 1°C on the north side; on March 26, 1956, when the air temperature was 1°C, on the south side of a birch stump with smooth white bark it was 15°C and on the north side –5°C (snow still lay there). Considering the fact that night frosts are very common at this time, the temperature conditions on the north side of the stump must have been much more stable.

It may be surmised that higher temperatures cause the ichneumons to accelerate their expenditure of food supplies; this appears the more probable since these insects are active at very low temperatures: I. extensorius displays weak activity at – 5° C. However, some of the ichneumons hibernate in well-warmed shelters, undergoing sharp temperature fluctuations and not abandoning them prematurely (see below). The number of deaths under these conditions is not known. Mortality among representatives of the Ichneumoninae, which predominate in hibernation sites, is generally insignificant: one I. cessator and St. scutellator were found dead. Temperature

TABLE 5

Specificity of the Fauna of Several Stations

Station	% species held in common, after Shorygin (1929)					% specific species
	No. 1	No. 2	No. 3	No. 4	average	
No. 1. Cleared area.	x	51	53	36	45%	15
No. 2. Spruce forest.	51	x	22	14	29	41
No. 3. Mixed forest.	53	22	x	56	44	33
No. 4. Pine forest	36	14	56	x	35	0

TABLE 6

Specificity of the Species Complexes in Several Types of Trees

Type of tree	% species in common, after Shorygin (1929)				% specific species
	No. 1	No. 2	No. 3	average	
No. 1. Pine	x	60	54	57	39
No. 2. Spruce	60	x	48	54	18
No. 3. Birch	54	48	x	51	28

and humidity conditions in the localities of their deaths were no worse than in the majority of other ichneumon shelters and could scarcely have been the causes of their death.

This low mortality among ichneumons during the winter period is interesting in relation to the widespread, and apparently justified, belief that for the majority of insects high mortality is typical during the winter period (Kalabukhov, 1956).

Phenology of the Winter Period

Tables 1-4 demonstrate that ichneumon flies disappear into hibernation sites by no later than the second half of September or beginning of October, that is, approximately during the time of leaf fall. They will, however, apprently leave their shelters temporarily on sunny days at later dates. Analogous occurrences during winter and spring, even during strong warm spells, are not observed. Flight out of the hibernation sites takes place approximately during the period of sap flow in birch, that is, from the end of April to the beginning of May.

The Distribution of Ichneumons in Hibernation Sites

Hibernating Ichneumonidae are extremely unevenly distributed among the shelters, but a unit of estimation which would enable one to obtain sufficiently numerous, objective, and reliable data was not available. Consequently it was decided to avoid inconclusive attempts to establish any sort of quantitative differences between the populations of various shelters. Only a few more or less reliable numbers were obtained. Orthocentrus asper was not taken into account in the analysis of the general picture of distribution since this very abundant species, making up almost half of all the collected ichneumons, strongly distorted the average figures.

Distribution by Stations

Kolybaev (1937) wrote that ichneumon flies avoid dense, dark forests. In our collections, hibernation sites in spruce and pine woods were always concentrated near roads, along the edges, and in clearings.

The following areas were studied in more detail than the other stations: mixed forests (127 specimens of 24 species collected), spruce forests (179 specimens of 17 species), pine forests (27 specimens of 9 species), and a cleared pine wood planted with young pine and birch (178 specimens of 20 species). The least number of ichneumons was found in the pine forest, the most in the spruce forest and the cleared area. The latter areas are especially varied in vegetation and it is not surprising that the abundant ichneumons overwintering there consist of various species. But it is strange that the percentage species in common in the ichneumon fauna should be comparatively high in those areas (see Table 5 and dominant species).

It should also be pointed out that the large numbers of ichneumons in the cleared area arise from the presence of large numbers of excellent shelters, in each of which there are rarely more than 10 insects hibernating together. In the spruce forest, on the other hand, there are very few suitable shelters, in which up to 100 ichneumons sometimes congregate.

On the basis of the data in Table 5 it may be stated that the fauna of the spruce forest is apparently the most specific. For the other stations, the percentage of species held in common exceeds that of specific species. The average percentage of species held in common in the populations of all stations is 38%, that for specific species is 22%.

The following species are dominant, composing more than 10% of the insects collected (except Orthocentrus): in the spruce forest: — I. memorator and P. turionella; in the mixed forest — I. extensorius, I. gracilentus, and I. memorator, in the pine wood — I. gracilentus and I. memorator, and in the cleared pine grove — I. extensorius and I. gracilentus.

Distribution According to Tree Species

Data on ichneumon hibernation sites in the trunks of the following trees were taken for comparison: pine (441 specimens of 36 species), spruce (160 specimens of 17 species), and birch (65 specimens of 18 species).

Ichneumons overwinter most frequently under the bark and in the wood of pine; if suitable pine stumps are present among spruce trees, there are comparatively very few hibernating ichneumons in the latter. There are few birch stumps which provide suitable hibernating places in nature; dead birch wood is not resistant enough to climatic and microbiological influences. Consequently, the number of ichneumons hibernating in birch is very variable; if there are also birch stumps among the spruce they will sometimes be very lightly inhabited, but in other cases no fewer, and sometimes even more, ichneumons overwinter in birch as do in the surrounding pine stumps.

In spite of the fact that the percentage of specific is greatest in pine and least in spruce (Table 6), it is difficult to speak of specificity in the populations of different trees since the mean percentages of species held in common are almost the same. The mean percentage of specific species is 27, that of species held in common is 54%. The following are dominant: on pine — I. extensorius, I. gracilentus, and I. memorator, on spruce — I. memorator and P. turionella, and on birch — I. gracilentus.

Characteristics of the Distribution of Several Species of Ichneumons

1. Hoplismenus. All the members of this genus which we collected were overwintering in association with other ichneumons.

2. Stenichneumon scutellator. Found four times (28 specimens), always with no or comparatively few other species present. Three times out of the four the ichneumons were overwintering under the bark of trees at a considerable height (2-3 m). The distribution by stations and types of trees could not be determined.

3. Ichneumon extensorius. The commonest species (with a frequency of 44±6%). Of 175 specimens 74 were found in the cleared pine forest, 21 in mixed forest, 9 in spruce forest, and 2 in pine forest. 152 specimens were found on pine, 14 on spruce, and 7 on birch. It is dominant in the first two stations and in the pine forest, often overwintering in large groups in a single place (25-40 individuals in the clearing, 25-46 in pine) in the cleared mixed forest and in the pine forest. It apparently most characteristic of pine and pine clearings.

4. Ichneumon gracilentus. The second species in frequency of occurrence (40±6%). Of 108 specimens 47 were found in clearings, 32 in mixed forest, 6 in pine forest, 74 on pine, 26 on birch, and 8 on spruce. It is dominant in pine forest, in clearings, in mixed forest, and even on pine and birch. In clearings large aggregations are characteristic (18-19 specimens) and also in pine (18-20 specimens). It is similar in distribution to I. extensorius but more even.

These two species are never found in large numbers together in the hibernations sites. The species which is overwintering in number of 4-5 or more in any single place is always strongly dominant. The preponderance of one species or the other in relation to station or type of tree was not determined.

5. Ichneumon memorator. The frequency of occurrence of this species was less than that of I. gracilentus (33+6%), but the over-all number of collected individuals was greater than that for any other Ichneumoninae — 178. This is explained by the fact that I. memorator collects in very large groups of us to 80 individuals more frequently than any other species. The collected individuals of this species were distributed in the following fashion: 99 insects hibernating in spruce forest, 15 in mixed forest, 11 in pine forest, and 7 in cleared areas; 97 ichneumons were found on pine, 53 on spruce, and 4 on birch. It is dominant in spruce, mixed, and pine forests, on pine and spruce. Of the four stations large aggregations were found only in spruce forest (68-80 individuals) and, moreover on pine (80) and spruce (18-22). However, the differences in frequency of occurrence of this species according to station and type of tree are inconclusive; it may only be stated that I. memorator predominates in hibernation sites on pine, spruce, and in spruce forests.

6. Ichneumon latrator. All specimens of this species, except for one which was hibernating in moss, were found under the bark of pine at the edges of pine woods and shrubby growth.

7. Pimpla turionella. Found in hibernation sites three times, always in spruce forest. One individual was hibernating on pine and 50 on spruce. As mentioned above, the latter died after the frosts of 1956.

8. Orthocentrus asper. The most numerous species (about 620 specimens were collected), but its frequency of occurrence was not more than 22+5%. This is expained by the fact that O. asper most frequently overwinters in large aggregations which contain up to 190 individuals. Two thirds of our collections of this species were represented by groups of more than 15 specimens each. The distribution by stations is the following: pine forest 130 specimens, clearings 80 specimens, mixed forest 60, spruce forest 10. About 600 ichneumons were found on pine, 3 on spruce, and none on birch. The preponderance of O. asper on pine is conclusive, in pine forest it is highly probable, considering the extensive, but inconclusive, differences between the frequencies of occurrence (43±20%and from ±5% to 17±15%).

SUMMARY

About 1370 females of fifty different species of ichneumon flies were collected in their hibernation sites in the Moscow and Kalinin regions. Among these, twenty-three species are recorded as hibernating as the imago for the first time.

The ichneumon flies collected were overwintering under the bark and in the wood of trees, tree trunks, and also, apparently, in forest litter. Ichneumon flies hibernate in moist shelters, mostly under conditions of relatively constant temperature (lower parts of tree trunks facing north), but they are capable ofenduring severe frosts (some species survive at — 40°C) and abrupt changes of temperature.

Among the species found in hibernation sites mortality is quite insignificant.

In dense spruce and pine forests hibernation sites are situated near open spaces.

The disribution of ichneumon flies in hibernation sites in spruce forests and in pine trees growing in clearings in pine forests. The majority of most common species preferably overwinter in pine trees. Clearings in pine forests are the most characteristic locality for Ichneumon extensorius and I. gracilentus, while spruce forest and pine forest are characteristic of I. memorator and Orthocentrus asper respectively. Great accumulations of hibernating individuals are characteristic of the latter two species, especially for O. asper. Neither I. extensorius nor I. gracilentus form such accumulations simultaneously. Stenichneumon scutellator hibernates separately from other species,or with but a slight admixture of representatives of other species.

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BIOLOGY AND ECOLOGY OF ROBBER FLIES (DIPTERA, ASILIDAE) IN THE NARYN SANDS

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Robber flies play a very important role in the life of the insect complexes of the sandy areas of the Lower Trans-Volga. They are voracious predators and actively destroy large numbers of injurious insects, a large percentage of which consists of chafers, locusts (Fedorov, 1925; Bogush, 1949; Davletshina, 1949; Shtakel'berg, 1950), grasshoppers, bugs and even the blister beetles Epicauta [Cole, 1958]. On the destruction of insect pests by robber flies Shtakel'berg [1950] wrote: "Certain steppe species of robber flies are represented in suitable conditions by an extremely large number of individuals, sometimes by masses, and in these cases their role as an element of the landscape and their economic importance are very considerable."

Information on the biology of robber flies in the USSR is still inadequate. In individual works we can find mention of their beneficial activity and data on the numbers of larvae of this family in various types of soil. The biology of the robber flies of southeast Kazakhstan has been described in detail in Ler's works [1958a, 1958b].

We reported previously on the rich Asilid fauna of the Naryn Sands (west Kazakhstan), which included a new genus Eremisca Zin. [Zinov'eva, 1956].

The Naryn Sands have been fully described in the literature and represent an interesting subject for entomological studies. They constitute a unique, isolated sandy massif in the midst of a typical semidesert landscape. This massif consists of 20-30 km long ribbon-like ridges ("Naryns" in Kazakh) of sandy hills separated from each other by valleys ("ashiks" in Kazakh) with meadow-steppe vegetation. The width of the ridges reaches 5-20 km, and the width of the ashiks 10-20 km. In the hollows formed by the wind in the sand hills and on the gentle slopes of the small hills there occur thickets of woody vegetation, mainly the Naryn poplar. These sands were described by us in more detail in a study of their soil insect fauna [Zinov'eva and Rafes, 1954]; there also we drew attention to the beneficial activity of robber flies, and this present paper is devoted to their biology.

In carrying out the work the author made good use of the advice and assistance of A. A. Shtakel'berg, E. S. Smirnov, and E. A. Afanas'eva of the Laboratory of Diptera ZIN AN SSSR, to whom the author expresses his deep gratitude.

The observations on the mode of life of robber flies were made in 1952-1953 and in 1956.

In the Naryn sand massif robber flies are the principal destroyers of injurious chafers and certain other insects (see table). Here we found 14 species of robber flies. The fullest information was gathered on 9 species: Leptogaster cylindrica Deg., Satanas gigas Ev., Polysarca ungulata Pall., Apoclea helvipes Lw., Machimus gonatistes Zell., Echthistus rufinervis Wd., Neomochterus perplexus Beck., Astochia caspica Herm. and Eremisca vernalis Zin.

From the zoogeographical aspect our species list of robber flies is inhomogenous. Along with typical European-Siberian species – E. rufinervis, L. cylindrica and M. gonatistes – we find representatives of Turanian-African origin – P. ungulata, S. gigas, A. helvipes and others.

As we mentioned above, robber flies are active predators. They mainly attack moving prey, seizing it in flight. An exception is L. cylindrica, which flies among the herbage and seizes small insects which it comes

TABLE

Composition of Food (Victims) of the Main Species of Robber Flies

Species	Orthoptera	Winged ants	Cicadas	Odonata	Bugs	Noctuidae	Lycaenidae	Pyralidae	Tineidae	Tabanidae	Small diptera	Chrysomelidae	Buprestidae	Anisoplia spp.	Anomala errans F.	Polyphylla alba pall.
Leptogaster cylindrica	+	−	+	−	+	−	−	−	+	−	+	−	−	−	−	−
Satanas gigas	+	−	−	+	+	+	−	−	−	+	−	+	+	+	+	+
Polysarca ungulata	+	+	−	−	+	−	+	+	+	−	+	−	−	−	−	−
Machimus gonatistes	+	+	+	+	+	+	+	−	−	+	+	+	+	+	+	+
Neomochterus perplexus	−	+	−	−	+	−	−	−	−	−	−	−	−	+	−	−
Astochia caspica	−	−	−	+	−	−	+	−	−	−	+	−	−	+	+	−
Apoclea helvipes	−	−	−	−	−	−	−	+	−	−	+	−	−	−	−	−
Eremisca vernalis	−	−	+	−	−	−	−	+	+	−	+	−	−	−	−	−
Echthistus rufinervis	+	+	−	+	+	−	−	−	−	−	+	−	−	+	+	−

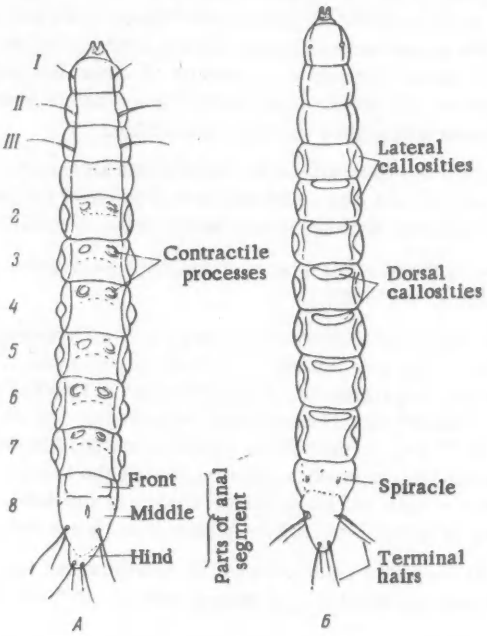

Fig. 1. Leptogaster cylindrica Deg. First-instar larva. A) Ventral aspect; B) dorsal aspect.

across, including those at rest. The other species (E. rufinervis, Ast. caspica and A. helvipes) sit in an expectant attitude on the herbage, shrubs or on the sand. When they see a victim, they pounce swiftly on it. Finally, S. gigas, N. perplexus and P. ungulata make short flights over their hunting territory and seek out their prey. Even when caught in the net a robber fly usually does not let go its victim. It grips it with its fore legs, which are armed with spines, bristles and hairs, and quickly plunges its stout sharp proboscis into the victim. Even the elytra do not save beetles. Shtakel'berg [1950] mentions that the proboscis of the robber fly penetrates the fine membrane at the articulation of head and thorax; we observed the penetration of the proboscis between the scutellum and elytron, usually under the left one.

In the struggle for life and food the robber flies are not always the victors: large spiders and the wasps Crabro catch and kill robber flies [Cole, 1958].

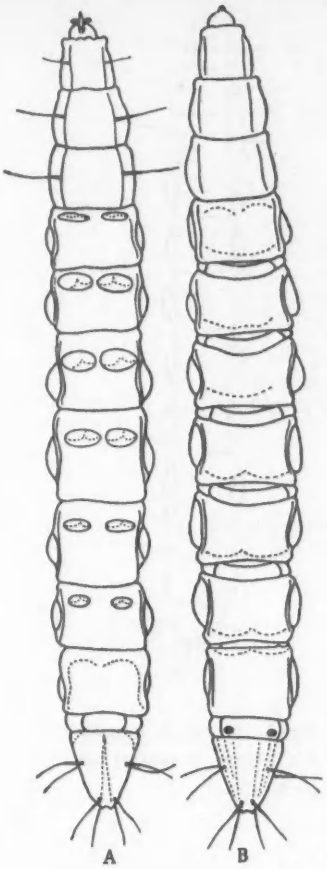

Fig. 2. Satanas gigas Ev. First-instar larva. A) Ventral aspect; B) dorsal aspect

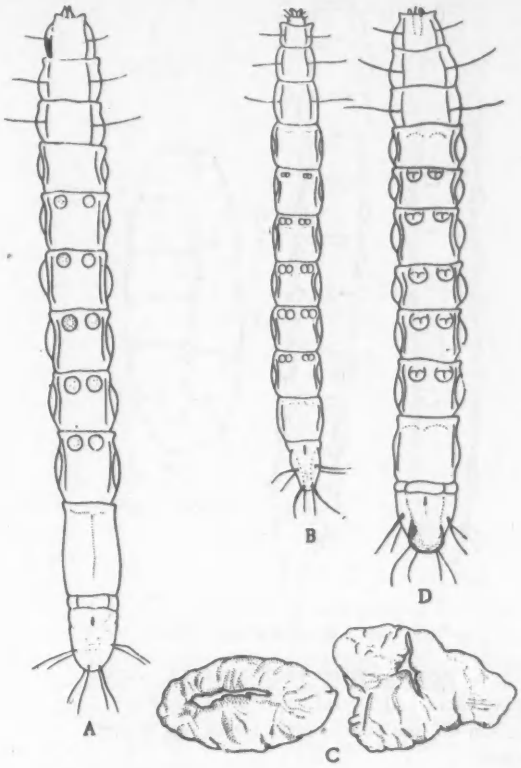

Fig. 3. A) Apoclea helvipes Lw.; first-instar larva in ventral aspect; B) Machimus gonatistes Zell.; larva in ventral aspect; C) the same, abdominal contractile callosity of 1st segment; D) Echthistus rufinervis Mg.; first-instar larva in ventral aspect.

Robber flies hunt from early morning to the end of the day. The times of daily activity depend on the temperature of the air and sand, the strength of the wind and the degree of sunlight. In overcast and cold weather the robber flies sit on the wormwood bushes, on the underside of licorice leaves, on the bark of trees on the lee side and in crevices in the bark. In these spots they spend the night.

In hot weather when the wind is strong the species of open localities hunt during periods of calm. During the gusts of wind they settle on the sand, gripping firmly by their tarsi. The sand, drifted by the wind, gradually covers almost the whole fly, so that only the head is visible on the surface of the sand. When the wind carries the fly too far down the slope of the dune or when danger threatens, the robber fly takes wing and settles on another spot.

All the robber flies can be classed into two groups according to their daily activity: European-Siberian and Turanian. Representatives of the first group fly out on the hunt very early. M. gonatistes, for instance, according to observations on June 25, 1953; began to fly slowly from bush to bush at 5.30 a.m. At 6.30 a.m., when the sand had warmed up to 19°, the robber fly settled for a short time on the sand and then again flew on to the wormwood shrubs.

During this time the more thermophilic species of the second group (representatives of the Turanian fauna) still remained motionless on the bushes. When the sand temperature reached 23-24° (at 7 a.m.) they began to alight on the sand and to bask in the sun for a long time.

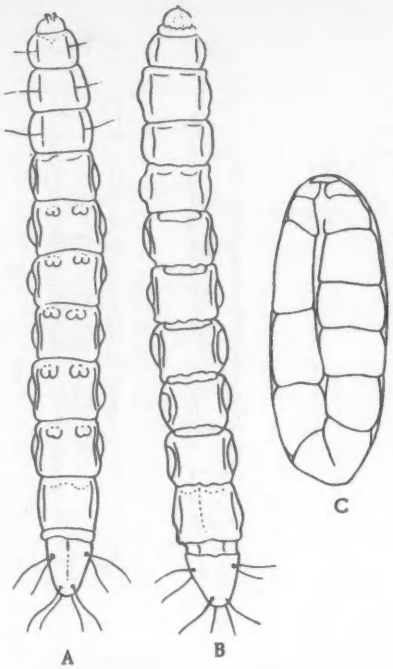

Fig. 4. Neomochtherus perplexus Beck. First-instar larva. A) Dorsal aspect; B) ventral aspect; C) position of larva inside egg membrane.

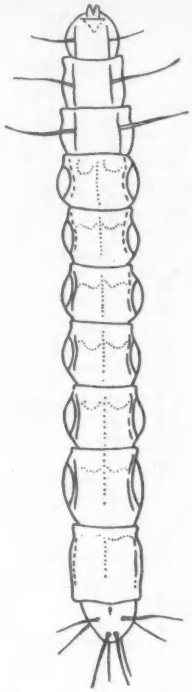

Fig. 5. Eremisca vernalis Zin. Larva in ventral aspect.

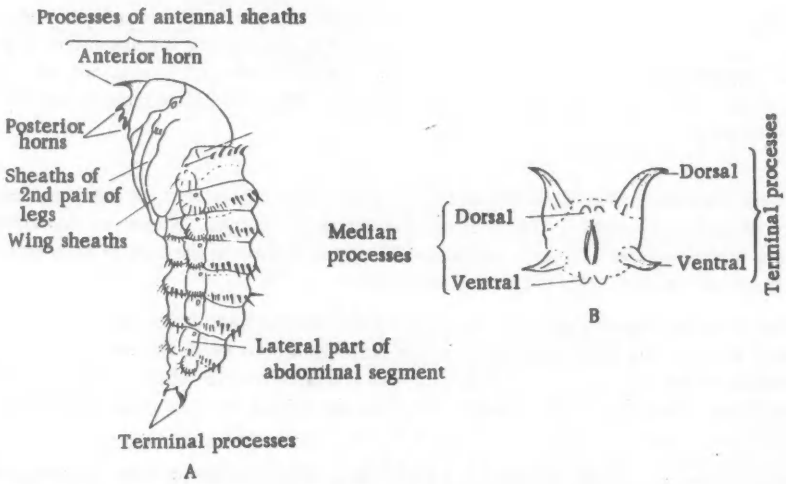

Fig. 6. Machimus atricapillus Fln. A) Pupa from side; B) terminal processes of pupa from behind.

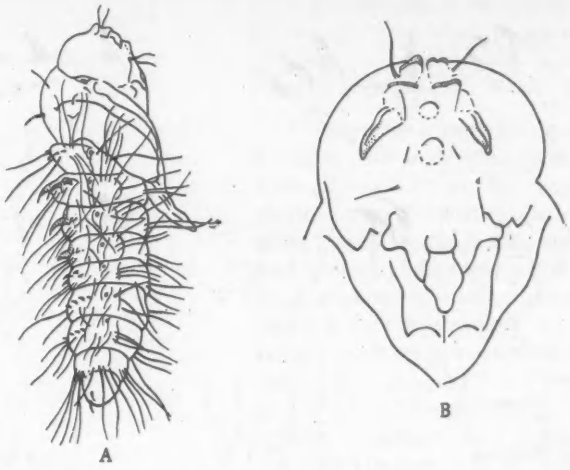

Fig. 7. Leptogaster cylindrica Deg. A) Pupa from side; B) head end of pupa from front.

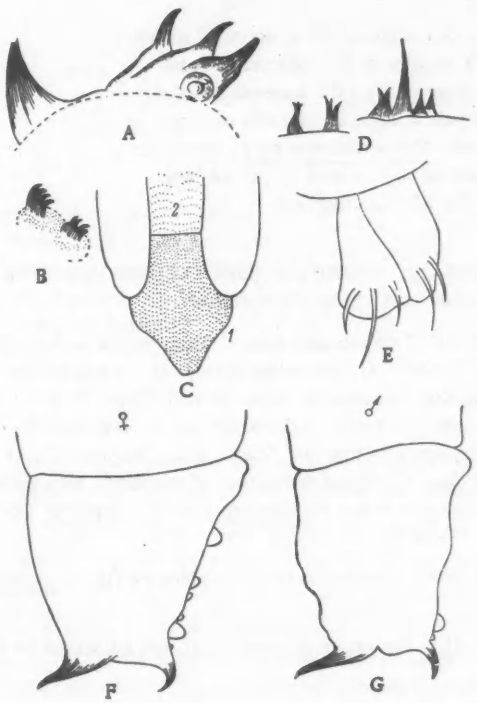

Fig. 8. Satanas gigas Ev. Pupa. A) Appendages of antennal sheaths; B) hooks at base of middle pair of legs; C) hypopharyngeal sheath (1) and labrum sheath (2); D) spines of abdominal segments; E) lateral part of last segment; F) last segment of female pupa; G) same of male.

The flight of the second group ended first—at 6 p.m., and the second group later — at 7-8 p.m. The daily activity of the robber flies was closely correlated with the rhythm of life of their victims. This was well seen in the case of M. gonatistes, which plays the chief role in the destruction of chafers, particularly the widely distributed sand chafer (Anomala errans F.). This chafer begins to take wing in large numbers at 8 p.m. Correlated with this, the period of activity of the robber flies is extended: at 10.30 p.m. we could still find robber flies hunting chafers.

Bogush [1949] recorded the activity of the robber fly S. gigas about 10 p.m. on a dark evening in Bairam-Ali, when it was caught with a sphinx moth Celerio hippophaes Esp.

Each species of robber fly has its own hunting territory, occupying a particular habitat. E. rufinervis and L. cylindrica live on ashiks with dense meadow vegetation, but they hunt in different levels of the vegetation; L. cylindrica flies among the grass and captures small insects, while E. rufinervis hunts above the surface of the grass cover, flying up on to the mammoth wild rye (Elymus giganteus Vahl.) and destroying large numbers of Anisoplia beetles. When caught, this robber fly defends itself very vigorously; it seizes the finger with its tarsal claws, which pierce the skin, stabs with its proboscis and exudes at the same time a brownish foamy fluid. E. rufinervis is also found among small dunes, in saucer-shaped hollows with dense grass cover. M. gonatistes occurs on bare patches of the ashiks and on paths.

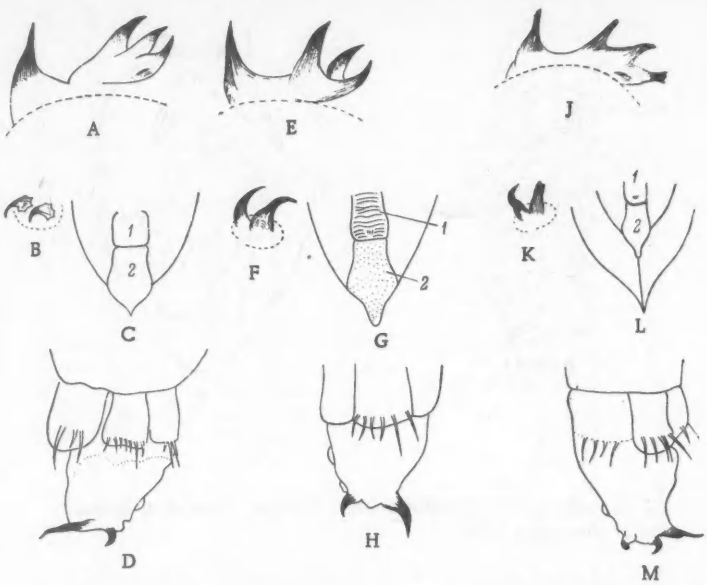

Fig. 9. Pupae. Machimus gonatistes Zell.: A) appendages of antennal sheaths; B) hooks at base of middle pair of legs; C) sheaths of hypopharynx (1) and labrum (2); D) last segment. Echthistus rufinervis Mg.: E) appendages of antennal sheaths; F) hooks at base of middle pair of legs; G) sheaths of hypopharynx (1) and labrum (2); H) last segment. Neomochtherus perplexus Beck. J) appendages of antennal sheaths; K) hooks at base of middle pair of legs; L) sheaths of hypopharynx (1) and labrum (2); M) last segment.

On transition from ashiks to sandy hills there is a zone of small mounds overgrown with wormwood. Here P. ungulata is found. It often hunts along the paths for lycaenids, ants and small dipterans.

As regards phenology, E. vernalis appears first (May 22, 1953) on the sand dunes. This species sticks to the tops of the dunes, on the loose sand, where the stiletto flies (Therevidae) flew before them. At the end of May (May 31, 1953) A. helvipes appears and occupies the tops and bare slopes of the dunes in early June. By this time E. vernalis has disappeared from the dunes and solitary specimens are found on the paths. In the last third of June A. helvipes was apparently displaced from the tops of the dunes by the wasp Stizus, which began to fly in large numbers at this time. When the wasps appeared A. helvipes descended to the foot of the dunes, into hollows with sparse herbage and was even found at the edges of plantations – where M. gonatistes and N. perplexus usually hunted.

On bushes of rosemary willow and Caspian willow and also in plantations of black alder we find N. perplexus and Ast. caspica.

Poplar groves in small hollows and on level areas, as well as the slopes of small, hills, are colonized by S. gigas.

M. gonatistes is most widely distrubuted in the sands. It is found in almost all the plantations, in hollows overgrown with dense herbage, on paths and on the ashiks, but it avoids the tops of the sand hills and easily drifted sand.

Oviposition in robber flies begins 10-11 days after the flight begins. The number of eggs in small forms varies from 20 to 30, and in large ones from 20 to 130. The eggs are cemented to plants (E. rufinervis), buried in the sand (E. vernalis, A. helvipes) or simply scattered on the surface of the sand (L. cylindrica). When the female has laid its egg it dies.

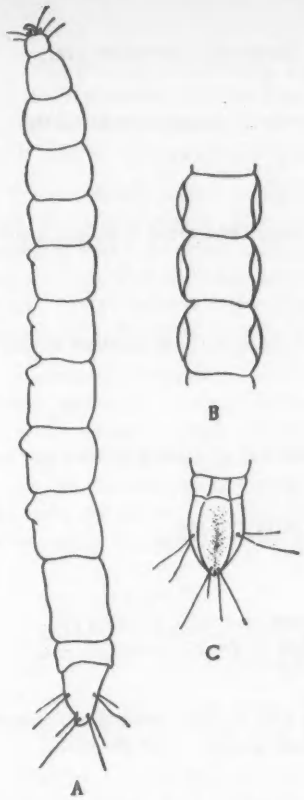

Fig. 10. Astochia caspica Herm. A) First-instar larva; B) abdominal segments IV-VI in dorsal aspect; C) anal segment in ventral aspect.

The life span of the flies varies: from 7-10 days (E. vernalis, A. helvipes, P. ungulata) to 2½ months (S. gigas, M. gonatistes, L. cylindrica). Jackosn [1954] indicate similar times for African robber flies.

The larvae emerge after 5-6 days, sometimes within 3-4 days, while in E. rufinervis in one case the larvae even appeared within 2 days after the eggs were laid. It is possible that the period of larval development depends on the time of egg laying and the feeding the of imago. Eggs laid at the beginning of the flight period take longer to ripen (6-7 days), while the eggs laid at the end of the flight period complete their development in 2-3 days. From the eggs of a single batch the larvae sometimes do not emerge immediately, but in groups of 7-10. For instance, a female M. gonatistes laid 29 eggs on July 15, 1953. The first larvae appeared on June 17, some appeared on June 19, and the last 7 larva on June 21. This phenomenon has its own biological significance: The appearance of the larvae in small numbers affords them better feeding possibilities. When they have become stronger, they migrate to other spots in search of food. Moreover, this makes a protracted flight period possible; in the opposite event the appearance in the field all at once of a huge number of such voracious carnivores would hardly allow them sufficient nourishment.

The larvae pupate in the upper layers of soil at depth 10-15 cm. The pupa takes 2-2½ weeks to develop. Before the emergence of the imago the pupa moves up to the very surface of the soil, so that after the flies have emerged the pupal shucks project halfway out of the soil. On loose sand, the shuck is found on the surface.

Description of Eggs, Larvae and Pupae of Some Robber Flies of the Naryn Sands

The structure of the larva and pupa has been described in detail by Melin [1923]. Figure 6 gives the terminology of the parts of the pupa. Melin compiled keys to the larvae and pupae of species occurring is Sweden. In later years, Melin's results have mainly been used [Séguy, 1927; Engle, 1930; Henning, 1952]. Several new larvae of Egyptian Asilidae have been described in Efflatoun [1934].

In the present paper we give a description of the eggs, larvae and pupae of the robber flies which we studied in the Naryn Sands.

Key to First-Instar Larvae

1 (2) Contractile processes absent. Lateral callosites very large, making the segments appear barrel-like. Anal segment small, with ventral side strongly concave – E. vernalis Zin.

2 (1) Contractile processes present.

3 (4) Bristels of anal segment situated in hind third of segment. Anal segment consisting of three parts. Larva small, yellowish white – L. cylindrica Deg.

4 (3) Bristles occupying half, or more than half of anal segment.

5 (8) Bristles encroaching on to fore half of anal segment.

6 (7) Bristles occupying $\frac{3}{4}$ of anal segment, which consists of two parts. Contractile processes oval, entire. Larvae large, white, attaining 53 mm in last instar – S. gigas Ev.

7 (6) Bristles encroaching slightly on to fore half of anal segment. Contractile processes indistinctly divided. Segments almost square – N. perplexus Beck.

8 (5) Bristles situated only in hind half of anal segment.

9 (10) Contractile processes consisting of two parts. Segments clearly longer than broad – M. gonatistes Zell.

10 (9) Contractile processes round, entire.

11 (12) Contractile procesesses round, small and distinctly salient, with two apices, and situated in fore third of segment. Anal segment long, tapering – Ast. caspica Herm.

12 (11) Contractile processes round, slightly flattened.

13 (14) Length of segments gradually increasing caudad. Length of abdominal segment VII twice its breath. Anal segment broadly rounded – A. helvipes Lw.

14 (13) All segments of same size. Anal segment broad with keel – E. rufinervis Mg.

Key to Pupae Found in Samples

1 (2) Posterior processes of antennal sheaths absent. Third pair of legs long, reaching segment IV. Lateral parts of last segment with 3-4 bristles. Last abdominal segment with two spine-like processes – L. cylindrica Deg.

2 (1) Posterior processes of antennal sheaths present, horn-shaped. Third pair of leg sheaths short, scarcely reaching center of segment III. Lateral parts of last segment with more than four bristles. Last abdominal segment with 4 processes, the middle ones being knob-like.

3 (6) Lateral part of last segment with 5 bristles.

4 (5) Laternal part of last segment cleft. Hypopharynx (hypopharyngeal sheath) dark colored; labrum (labrum sheath) slightly wrinkled – S.gigas Ev.

5 (4) Laternal part of last segment entire. Hypopharynx light colored; labrum smooth. Third tooth of posterior horns broadly blunt – N. perplexus Beck.

6 (3) Laternal part of last segment bearing more than 5 bristles.

7 (8) Laternal part of last segment with 6 bristles. Hypopharynx darkened; labrum coarsely wrinkled – E. rufinervis Mg.

8 (7) Laternal part of last segment with 7 bristles. Hypopharynx light colored; labrum square. Horns very pointed. Dorsal terminal process 3 times longer than ventral – M. gonatistes Zell.

Leptogaster cylindrica Deg.

Dwells on ashiks with high, dense, meadow vegetation. On wing from end of May to August. Start of flight coincides with the blossoming of Peganum harmala and Achillea.

Distribution: whole of Europe and Siberia; extends into Central Asia, where it rises into the hills to 2000 m [Ler, 1958a].

Egg broadly oval, with rounded ends, yellowish brown. Membrane fine, smooth Size 0.43 x 0.36 mm. During oviposition the female sits in a resting attitude on a grass stem, and, flexing the abdomen, casts one egg after another at intervals. The eggs fall on the ground among the vegetation. This mode of oviposition is correlated with the structure of the end of the abdomen which is not specialized and does not form a true ovipositor.

The first-instar larva (Fig. 1) is dorsoventrally flattened, yellowish white. There are 6 pairs of ventral contractile processes; they are oval-shaped and arranged at an angle to the longitudinal axis of the body. The laternal and dorsal callosities are small. The anal segment consists of three parts, the middle one being large. The bristles are situated in the hind third of the segment.

Pupa whitish, with a covering of long hairs. Size 6 x 1.6 mm (Fig. 7). Head with antennal sheaths wide apart and lacking posterior processes; anterior processes not horn-like, but forming 2 connected quadrangulate elevations with a transverse marginal crest, on the inner side of which there is a long bristle. In the center of the face,there are 2 small rounded elevations (Fig. 7, B). At the base of the hook-like sheaths there are 2 short bristles, and at the base of the sheaths of the second pair of legs, there is another bristle. The thorax has 4 bristles arranged to form a square on the dorsal side.

Abdominal segments I to VII dorsally with a transverse series of claw-like, dark brown, strongly curved spines. On segment I, there are 5 of these, on VIII, there are 4, and on all the rest are 7 each. On segment I, the spines are rather small, while on segments II-IV they are usually well developed. The bristles are very long, brownish. On dorsal side of segments I-VII there is a transverse row of bristles situated at the base of these spines. On the fore part of the last segment the bristles on the dorsal side are arranged in 2 rows, while the lateral part bears one row of 4 bristles. The hind part of the last segment is rounded and provided with 2 short terminal spines, which are curved inward and branch at the apex.

Santanas gigas Ev.

Occurs predominantly in poplar groves, in shallow hallows and flat areas. On wing from mid-June till August. In Turkmenistan the flight begins in late April, in Iran it lasts from April to September [Becker, 1912].

Distirbution: South and southeast of European USSR; extends northward to Bryansk region (collections to V. N. Stark, 1925); Central Asia, Mongolia [Engel, 1934], Iran and Egypt.

Egg very large, broadly oval, of whitelcolor with structureless membrane. Size 3.4 x 1.3 mm. Female sheds eggs directly on to the sand or buries them near the surface.

Larva (Fig. 2) cylindrical, white in color. Length in first instar 4.1 mm, in last 53 mm. Abdominal segments almost square; their sizes do not change with approach to anal segment; all segments with coarse longitudinal striation. Contractile processs transversely oval, broad, numbering 6 pairs, the largest on abdominal segments V and VI; on segment I they are small and narrow. Lateral callosities large. Dorsal callosities broad, numbering 6 pairs. Anal segment with notched end, and consisting of two pairs, front part smaller than hind part. Bristles occupy $\frac{3}{4}$ of segment. Spiracles very large, oval.

Pupa of dark brownish color, size 41 x 8.1 mm. Processes of antennal sheaths large (Fig. 7), horn-like. Anterior horns long, pointed, posterior blunter, the third being quite blunt, and with a large thickening at base. At base of sheaths of second pair of legs, there are broad, stout hooks (Fig. 8, B) with 4-6 teeth. The labrum is longer than broad, and weakly wrinkled. The hypopharynx is dark (Fig. 8, C, 1).

On the dorsal side of abdominal segment I, there are 26 large, thick spines, pointing backward ; on the remaining segments the large spines alternate with 3-5 smaller ones, these often having split apices (Fig. 8, D). The hairs on the abdominal segments, are stout, weakly bent, spiniform.

On the lateral parts of the abdominal segments there are 16-18 long bristles arranged in pairs. The lateral part of the last segment consists of two halves and bears 5 hairs (Fig. 8, E). The lsat segment of the fermale bears 5 pairs of tubercles ventrally (Fig. 8, F), and of the male – 1 pair of tubercles (Fig. 8, G). The median processes are small. The terminal are stout, the anterior one strongly curved inward , and the posterior one almost straight, twice as large as anterior.

Apoclea helvipes Lw.

A typical representative of the sandy desert. Occurs on sand dunes in Urda.

On wing from end of May to mid-June (May 31-June 11, 1953) during the blossoming of the oleaster and the salt tree (Halimodendron).

Distribution: Algiers, Iran, Asia Minor [Engle, 1934], Malye Barsuki sands [Luppova], Trans-Caspian region [Gussakovskii], Urda, Chelkar in Aktyubinsk region.

Egg broadly oval (greatest width in middle), of white color. Size 2.03 × 1.02 mm. Female lays eggs by thrusting ovipositor deep into the sand.

The first-instar larva (Fig. 3, A) is cylindrical. Segments increase in length caudad. Length of abdominal segment VII twice its width. Contractile processes of round form, small. Lateral and dorsal callosities of medium size. Anal segment broadly rounded, weakly divided into 3 parts; bristles in hind half of segment not reaching middle. Spiracles round, small.

Machimus gonatistes Zell.

Occurs in Urda in various habitats. On wing from end of May to September. Start of flight coincides with flowering of dzhuzgun (Calligonum), briar and Koeleria.

Distribution: Central and southern Europe. In USSR extends northward to latitude of Leningrad [Shtakel'berg, 1954]; occurs in places in Central Asia.

Egg oval, with rounded ends, white. Size 2.1 × 0.74 mm.

Larva (Fig. 3, B) white, narrow, long. Abdominal segments longer than broad. Five pairs of contractile processes. Each of them consists of independent halves, which are particularly distinct in the fully grown larva. Small callosities on segments I and VII (Fig. 3, G). Lateral and dorsal callosities small. Anal segment long and narrow, slightly concave in middle; bristles situated in posterior half of segment, and reaching middle.

Pupa of brown color. Size 19 × 4.8 mm. Anterior horns of antennae very pointed, tapering over almost half their length. Posterior horns shortly pointed, the middle one a little bent at the tip, and the third with a small thickening at base (Fig. 9, A). At base of sheaths of second pair of legs there are 2 short, claw-like spines, the second being stronger (Fig. 9, B). Labrum almost square; hypopharynx light colored (Fig. 9, C). Dorsal spines of abdominal segments fairly strong; segment I with 12-13 long spines pointing forward. On remaining segments, the long spines alternate with short. Lateral parts of segments I and VI-VII with 7 bristles, remainder with 10. Median processes of last segment small. Ventral terminal process 3 times as long as dorsal, and curved caudad (Fig. 9, D).

Echthistus rufinervis Mg.

A characteristic representative of the steppe. In the northern area of steppe it occurs in places devoid of vegetation. In Urda, it is restricted to areas with dense meadow vegetation – ashiks and saucer-shaped depressions – and avoids bare sands. Noskiewicz [1953] classes this species as a meadow-steppe ecological type, when he described it in the fauna of the Pieprzow hills near Sandomierz (Poland).

On wing from beginning of June till August. The start of the flight coincides with the flight of the beetles Anisoplia deserticola Fisch., and A. segetum Hrbst, and with the flowering of the mammoth wild rye (Elymus giganteus Vahl.).

Distribution: Central Europe, central zone, south and southeast European USSR, Egypt.

Egg narrow oval, long, brown; membrane thick with granular structure, the granules forming polyhedral figures. Female cements eggs to leaves of herbage, stems and flowers. Size 2.0 × 0.51 mm.

First-instar larva squat; middle segments broader than long. Contractile processes round, large, situated in fore part of segment; some of them occupy up to half of the segment and stick out prominently above body surface. Lateral and dorsal callosities large. Anal segment broad, concave in middle and furnished with a keel at end (Fig. 3, D). Bristles reach middle of segment.

Pupa brown, squat. Size 21 × 5.5 mm. Antennal horns stout, heavily sclerotized, many-sided, pointed at tips. The third posterior horn is most strongly curved and is opposed to the other two (Fig. 9, E). At the base of the sheaths of the second pair of legs, there are long and bent hooks, one of them swollen at the base (Fig. 9, F). The labrum longer than broad, coarsely wrinkled (Fig. 9, G). Hypopharynx slightly darkened. On dorsal side of abdominal segment I, there are 12 very long spines and 2 small ones situated in the center of the segment; these

spines point forward . On the remaining segments, spines of normal size (about half length of previous ones) alternate with small ones. Hairs on ventral side of pupa long. Lateral parts carry the following numbers of bristles: segments I – 7, II and V – 10, III, IV, VI, VII – 8. Lateral part of last segment very broad, with 6 bristles. Median processes of last segment small. Terminal processes strongly curves inward , the posterior one a little larger than anterior (Fig. 9, H).

Neomochterus perplexus Beck.

Occurs in Urda in woods of black alder and govers of Caspian and rosemary-leaved willow (Salix caspica Pall. and S. rosmarinifolia L.). On wing from mid-June; start of flight coincides with flowering of Euphorbia.

Distribution: Steppe zone of USSR, Turkmenistan.

Egg oval, white, size 1.7 × 0.69 mm.

First-instar larva (Fig. 4, A, B) cylindrical, narrow, but not long. Segments almost square. Contractile processes small, oval, slightly divided in center. Lateral callosities small, dorsal narrow. Anal segment narrow. Bristles extend beyond center of segment.

Pupa pale brown, size 17.4 × 4.0 mm. Anterior horns of antennae long, slightly pointed, fairly broad at base. Posterior horns set wide apart from one another, blunt, third with broad apex and thickened at base (Fig. 9, J). Labrum smooth; hypopharynx pale (Fig. 9, L). At base of sheaths of second pair of legs there are stout denticles, of which one is strongly curved and the other is blunt-tipped (Fig. 9, K). On dorsal side of abdominal segment I, there are 18 large, stout spines and 2 small sharp ones, these being situated in middle of segment; these spines are raised slightly over the segment and are directed caudad. On the other segments, the large spines alternate with small spines; all these are weakly pointed, slightly bent at end. Lateral part of segments with very long bristles; on segments I and VIII there are 5, rarely 6 (if, so, 6th bristle is small). Remaining segments with 8 bristles. Median processes of last segment very large. Ventral median process is enlarged, occupying the site of the ventral terminal process which has been displaced caudad (Fig. 9, M). Ventral terminal process small, slightly bent at end. Dorsal process straight, a little than ventral, with forward-pointing tip (Fig. 9, M).

Eremisca vernalis Zin.

A typical representative of loose sands. On wing by end of May or early June. In the more southerly regions the flight begins earlier, at the end of April in Samarkand, for instance; in Urda in 1953 the flight began on May 22, coinciding with the flowering of the black locust and Amorpha, and lasted till June 5.

Distribution: Aral Kara-Kum, Turkmenistan, Tadzhik SSR, Urda, Chelkar in Aktyubinsk region, Priiliiskie Sands [Ler, 1958 a].

Egg oval, white in color. Size 2.03 × 1.02 mm.

Larva (Fig. 5) white, cylindrical. Segments braoder than long, barrel-like, with fine longitudinal striation. No distinct contractile processes; they are replaced by small invaginations in the center of the segment. Lateral and dorsal callosities very large. Anal segment small, $\frac{3}{5}$ length of segment VII, very concave on ventral side, convex dorsally, resembling a spoon in shape. Spiracles very small.

Astochia caspica Herm.

Occurs in groves of poplar and black alder, on clumps of rosemary-leaved and Caspian willow. When danger threatens, it flies aloft and, having flown several meters, settles on a branch on the side facing the sun. It avoids bare sands. On wing in June. The flight begins when the Gypsophila has flowered.

Distribution: Urda, Chelkar in Aktyubinsk region, Vakhsh [Gussakovskii], Lenkoran [Engle, 1934].

Egg long, with broadly rounded ends of pale brown color. The eggs in some cases are cemented tightly to one another in a group of 5-7. Size of egg 1.3 × 0.4 mm.

First-instar larva white, cylindrical. Lateral callosities very large, making abdominal segments I to VI appear barrel-like (Fig. 10, A). Contractile processes situated in fore third of segment (Fig. 10, B) small, entire, but, markedly convex, with two apices. Preanal and anal segments longer than all preceding ones. Anal segment consisting of two parts, long tapering sharply to end, the hairs situated in hind half of segment (Fig. 10, C).

Polysarca ungulata Pall.

Inhabits small hills overgrown with wormwood (Artemisia). It also hunts on paths and sands without vegetation. In Urda, it occurs in transitional localities between hills and ashiks.

The flight begins at end of May, in Turkmenistan in early May [Zimin, 1935], and continues throughout June.

Distribution: Asia Minor, Turkestan [Engel, 1934], Prikaspiiskie sands [Emel'yanov, 1930], Chelkar in Aktyubinsk region, Urda.

We did not manage to obtain any egg batches.

SUMMARY

This study of robber flies was carried out in the course of the investigation of the soil fauna of the Naryn Sands (west Kazakhstan region) during the period of 1952-53 and in 1956. The biology and ecology of nine species of robber flies have been studied.

The list of insect pests attacked, the time of flight, the duration of larval and pupal stages, and the habitats are indicated for each species of robber flies.

Keys for the identification of the larvae and pupae of these species found in soil samples are given.

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THE EPIDEMIOLOGICAL SIGNIFICANCE OF SYNANTHROPIC FLIES IN BUKHARA

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In spite of the fact that a considerable amount of literature has been devoted to the role of flies in the spread of enteric infections there is still no unified opinion with regard to the contribution of the fly factor in the epidemiology of these diseases.

Some investigators, headed by Gromashevskii [1952], ascribe to them an important role in the spread of acute enteric infections, while, others maintain that the role of flies is a very minor one, or deny them any significance at all.

These divergent opinions have arisen because the epidemiological role of flies must be assessed in relation to their biology and ecology in different geographical and landscape zones, and to the economic activity of man in each particular case. Many investigators have devoted their attention to the discovery of flies naturally infected with pathogenic microbes of the enteric group [Skavronskii, 1934; Shterngol'd, 1936, 1949; Pavlovskii and Bychkov-Oreshnikov, 1937; Zmeev, 1944a, 1944b, Shura-Bura, 1950a, 1951, 1952; Sukhova, 1950, 1951a, 1951b, 1954; Dykhno and Sukhova, 1952; Dykhno, Timakov and Sukhova, 1952]. However, the majority of authors have studied natural infectiveness only in the two subspecies of the house fly. Only Zmeev and Sukhova et al. have proved bacteriologically that some of the most widespread exophilous coprobiontic species of flies may be contaminated with dysentery microbes. On the basis of these results, certain hygienists and epidemiologists [Anastas'ev, 1952; Barinskii, 1952; Sinel'nikov, 1952] have concluded that it is necessary, in order to prevent dysentery, to take measures against not only the house fly, but, also against the commonest species of exophilous flies. Since the role of flies in the seasonal increase of dysetery in Central Asia still lacks an adequate biological foundation, we undertook bacteriological investigations of flies of different species in 1953-1955 in Bukhara, where there is a high incidence of dysentery. We take this opportunity of conveying our sincere thanks to B. L. Shura-Bura for the valuable advice which we received from him during the course of the work.

The flies were collected in the bazaar, in rubbish dumps, dust-bins, in latrines and in the surroundings of dysentery victims. We chose for investigation, the main, most frequented bazaar, which is situated in the center of the town, and where flies accumulate in greatest numbers the whole year round, since there they sell, often completely exposed, sweetmeats, fruits, juicy vegetables, and milk, meat and fish products. In addition, we find here other centers of attraction for flies, such as grocery stores, dining, tea and bakery stalls, stalls selling beer, wine and carbonated waters, and a large meat depot.

Situated close to the bazaar was the fever hospital, where we caught flies in the wards containing gastrointestinal cases and in the garden where some of the beds were put in summer. Near the bazaar and hospital, there were numerous breeding places for flies – waste food dumps, scattered pats of fecalia and piles of it outside latrines and the latrines themselves in the adjoining houses, all producing flies for 10-12 months in the year, owing to the poor santiation in this settlement.

*Delivered at the VIII Conference on Parasitological Problems in Leningrad in March, 1955.

TABLE 1

Distribution of Investigated House Flies According to Capture Sites and Months (1953)

	May		June		July		Aug.		Sept.		Oct.		Nov.		Total investigated	
	flies	indiv.	flies	indiv.	flies	indiv.	flies	indiv.	flies	indiv.	flies	indiv.	flies	indiv.	flies	indiv.
Bazaar	32	14	101	21	126	44	114	50	—	—	194	37	—	—	567	166
Eating-house .	—	—	25	4	40	4	21	4	—	—	37	7	17	17	144	36
Latrine . . .	—	—	53	16	43	10	28	10	—	—	10	1	—	—	134	36
Dust-bin . . .	—	—	12	3	11	2	22	7	—	—	10	1	—	—	55	13
Hospital . .	77	21	24	13	282	72	120	51	62	26	95	40	—	—	660	223
Total . . .	109	35	215	57	502	132	305	124	62	26	346	86	17	17	1556	474

The following method of investigation was employed. Regularly each week from May to mid- November, 1953, we caught flies on various products on sale in the bazaar, in latrines and in the beds of dysentery patients; these flies were put into sterile test tubes singly or in tens and quickly removed to the laboratory.

There the flies were identified, recorded in a notebook and immediately ground up in 0.5 cc of physiological saline in the same tubes until an even emulsion was obtained; 2-3 loopfuls of the emulsion were inoculated onto bacto-agar Zh. Depending on the growth of the colonies the inoculated plates were incubated in a thermostat for 1-2 days, and then 2-4 suspicious colonies were selected and seeded on lactose and then on a short color series. Bacteria which fermented lactose were not studied any further. Lactose negative bacteria, which behaved biochemically like dysentery bacilli, were subjected to a serological test by means of the appropriate dysentery sera — polyvalent Flexner, Grigor'ev-Shiga and Newcastle, titer 1 : 6400 (in 1953; in 1954, the first two sera had titers 1 : 4000, and the third 1 : 6400). All the sera were obtained from the Tashkent Institute of Sera and Vaccines, while in 1955, we obtained monoreceptor Flexner sera from the Pasteur Institute in Leningrad.

In 1953, we investigated 1556 southern house flies (Musca domestica vicina Mcq.) in 364, individual and 110 group samples, and 100 flies (68 individual and 11 group inoculations) belonging to 15 exophilous species.

Table1 gives the distrubition of the investigated house flies as regards sites of capture and months of 1953.

With the exception of 5 specimens of Sarcophaga haemorrhoidalis Mg., caught in a latrine, on isolated pats of feces and in a dust-bin, all the other 95 exophilous flies were captured on various products in the bazaar and on plants growing there.

In 1953, we isolated from the house flies 5 strains of the Flexner bacillus and 5 strains of Grigor'ev-Shiga, 7 cultures being obtained in June, 4 from flies caught in a latrine situated in the bazaar (1 Grigor'ev-Shiga and 3 Flexner) and 3 from flies caught on products in the bazaar (2 Grigor'ev-Shiga and 1 Flexner). This constituted 12.3% of the total number of 57 samples invesitgated in June, and with a different approach this percentage rises to 25% for strains isolated from 16 cultures made from flies caught in the latrine, and to 14.3% for cultures obtained from 21 seedings of flies caught in the bazaar.

In July, we isolated 3 strains (2 Grigor'ev-Shiga and 1 Flexner) from 72 samples of flies caught in the hospital, and thus, the infectivenss of the fly samples was 4.2%.

From 3 exophilous species (Muscina stabulans Fiiln., Fannia canicularis L. and F. scalaris F.) caught in the bazaar, we isolated 1 Flexner strain from each.

The cultural and serological properties of the 13 strains isolated in 1953 are given in the upper part of Table 2.

In 1953, we obtained another 5 atypical cultures of nonmotile Gram-negative bacilli (Table 3) of which Nos. 47, 48, 228 and 237 behaved on a color series like the Flexner bacillus, while No. 231 (an inoculation made

TABLE 2

Cultural and Serological Properties of Dysentery Cultures Isolated from Flies

No. of culture	Date of capture and plating of flies	Species of fly	Number of specimens	Site of capture
				1953
18	12 V	*Muscina stabulans* Flln.	1 ♀	Bazaar, currants
21	12 V	*Fannia canicularis* L.	1 ♀ 5 ♂♂	The same
94	15 VI	*Musca domestica vicina* Mcq.	10 ♀♀	Bazaar, latrine
96	15 VI	*Musca domestica vicina* Mcq.	10 ♀♀	Bazaar, khalva
107	22 VI	*Musca domestica vicina* Mcq.	10 ♀♀	Bazaar, latrine
109	22 VI	*Musca domestica vicina* Mcq.	2 ♂♂	Aerated water stall
114	22 VI	*Musca domestica vicina* Mcq.	1 ♀	Bazaar, khalva
119	22 VI	*Musca domestica vicina* Mcq.	1 ♀	Latrine
120	22 VI	*Musca domestica vicina* Mcq.	1 ♀	»
123	22 VI	*Fannia scalaris* F.	1 ♀	Bazaar, tree trunk
166	16 VII	*Musca domestica vicina* Mcq.	1 ♀	Dysentery ward
174	16 VII	*Musca domestica vicina* Mcq.	11 ♀♀	The same
177	16 VII	*Musca domestica vicina* Mcq.	10 ♀♀	»
				1954
2	23 III	*Calliphora erythrocephala* Mg.	1 ♂	Bazaar, cakes
175	16 IV	*Musca domestica vicina* Mcq.	1 ♀	Aerated water stall
324	25 IV	*Musca domestica vicina* Mcq.	1 ♀	Bazaar, grapes
325	25 IV	*Sarcophaga haemorrhoidalis* Mg.	1 ♂	The same
				1955
44	12 V	*Musca domestica vicina* Mcq.	10 ♀♀	Lemonade stall
129	11 VIII	*Musca domestica vicina* Mcq.	10 ♀♀	Meat depot
136	11 VIII	*Musca domestica vicina* Mcq.	10 ♀♀	The same
185	18 VIII	*Musca domestica vicina* Mcq.	10 ♀♀	Dairy stalls, bazaar
380	27 IX	*Musca domestica vicina* Mcq.	10 ♀♀	Bazaar, grapes

from 1 bazaar fly) behaved like the Grigor'ev-Shiga bacillus. When tested with polyvalent Flexner serum and Grigor'ev-Shiga serum, they gave a partial agglutination reaction, without giving a complete reaction even at the lowest titers.

Besides, the above-mentioned cultures we isolated from seedings of house fly emulsions another 54 strains (11.4%, according to total count) of Gram-negative, nonmotile bacilli which gave a delicate growth on bacto-agar Zh and resembled dysentery microbes in their biochemical characteristics. On a short color series, 31 strains broke down glucose and mannitol, 19 – only glucose, 3 – glucose, mannitol and saccharose, and 1 – only saccharose.

From the seedings of flies of 6 exophilous species (Musca sorbens Wd., M. osiris Wd., M. larvipara Portsch, Muscina stabulans Fllin., Calliphora erythrocephala Mg. and Sarcophaga haemorrhoidalis Mg.) we isolated 9

Behavior on color series						Agglutination with specific sera	
lactose	glucose	mannitol	saccharose	incole	H,S	titer	isolated
—	+	+	—	—	—	1 : 3200	Flexner dysentery bacillus
—	+	+	—	—	—	1 : 3200	The same
—	+	+	—	—	—	1 : 3200	"
—	+	+	—	—	—	1 : 400	"
—	+	+	—	—	—	1 : 6400	"
—	+	+	—	—	—	1 : 3200	Grigor'ev-Shiga dysentery culture
—	+	—	—	—	—	1 : 3200	The same
—	+	—	—	—	—	1 ; 3200	Flexner dysentery culture
—	+	—	—	—	—	1 : 3200	Grigor'ev-Shiga dysentery culture
—	+	+	—	—	—	1 : 3200	Flexner dysentery culture
—	+	+	+	—	—	1 : 3200	The same
—	+	—	—	—	—	1 : 3200	Grigor'ev-Shiga dysentery culture
—	+	—	—	—	—	1 : 3200	The same
—	+	+	—	—	—	1 : 1600	Flexner dysentery bacillus
—	+	—	—	—	—	1 : 400	Grigor'ev-Shiga dysentery bacillus
—	+	+	—	—	—	1 : 1600	Flexner dysentery bacillus
—	+	+	—	—	—	1 : 1600	Newcastle dysentery bacillus
—	+	+	—			1 : 3200	Flexner dysentery bacillus, type "f"
—	+	—	—	+	—	1 : 1600	Schmitz-Shtutser dysentery bacillus
—	+	—	—	—	—	1 : 1600	The same
—	+	—	—	+	—	1 : 1600	"
—	+	+	—	—	—	1 : 3200	Flexner dysentery bacillus, type "f"

similar strains, of which 3 fermented glucose alone with the evolution of acid, 3 — glucose and mannitol, and 3 — glucose, mannitol and saccharose.

None of the 63 cultures, the behavior of which on a color series recalled that of the Flexner, Grigor'ev-Shiga or Kruse-Sonné microbes, were even partially agglutinated by specific sera.

From March to December 1954, we studied 588 house flies (531 seedings) collected in the same places as in 1953. From them, we isolated 2 strains — 1 Grigor'ev-Shiga strain from 88 seedings made from 146 flies caught in the bazaar in June, and 1 Flexner strain from 140 flies (78 seedings) collected there in September.

In an investigation of 97 flies belonging to 15 exophilous species caught in the bazaar, we isolated a Flexner culture from 1 male Calliphora erythrocephala Mg. in March, and in September — 1 Newcastle strain from 1 male Sarcophaga haemorrhoidalis Mg., which had been "sitting" on grapes. A characterization of these 4 strains is given in the lower part of Table 2.

TABLE 3

Characteristics of Atypical Strains (1953)

No. of culture	Date of capture and plating of flies	Species of fly	Number of specimens	Site of capture	Behavior on color series						Agglutination reaction
					lactose	glucose	manni-tol	saccha-rose	indole	H_2S	
47	19 V 1953	*Musca domestica vicina* Mcq.	5 ♀♀ 2 ♂♂	Dysentery ward	−	+	+	−			Partial agglutination with Flexner serum
48	19 V 1953	*Musca domestica vicina* Mcq.	1 ♀	The same	−	+	±	−			The same
228	27 VII 1953	*Musca domestica vicina* Mcq.	1 ♀	Bazaar, latrine	−	+	+	−	−	−	"
237	27 VII 1953	*Musca domestica vicina* Mcq.	10 ♀	The same	−	+	±	−	−	−	"
231	27 VII 1953	*Musca sorbens* Wd.	1 ♀	Bazaar, unwrapped sweets	−	+	−	−	−	−	Partial agglutination with Grigor'ev-Shiga serum
52	21 IV 1954	*Muscina stabulans* Filn.	1 ♀	Bazaar, cakes	±	+	±	+	−	−	Partial agglutination with Flexner serum
347	1 X 1954	*Musca domestica vicina* Mcq.	1 ♀	Bazaar, on tree trunk	−	+	−	−	±	−	The same

In April and October, we also obtained 2 atypical Flexner strains from Muscina stabulans Filln. and M. domestica vicina Mcq., caught in the bazaar, and these gave only a partial agglutination reaction with polyvalent Flexner serum. Their properties are shown in Table 3. In addition, from seedings of emulsion of house flies collected in June, September, October and November, in the bazaar, we isolated 12 nonagglutinating cultures of Gram-negative, nonmotile, lactose-negative bacilli; 6 of them decomposed only glucose with the evolution of acid, 5 – glucose and mannitol, and 1 – glucose, mannitol and saccharose. Four similar cultures were obtained also from flies belonging to three exophilous species, collected in the bazaar. One strain isolated in March from Musca osiris Wd., fermented glucose, mannitol and saccharose; 2 strain isolated in March and April (1 each from Muscina stabulans Filln. and Sarcophage haemorrhoidalis Mg.) broke down glucose alone.

In 1955, from April 5 to December 27, we inoculated 430 plates with emulsions of M. d. vicina Mcq., 10 specimens being used for each inoculation, and 25 plates with 25 specimens of 4 species of exophilous flies (Muscina stabulans Filln. – 4 seedings, Calliphora erythrocephala Mg. – 3, Lucilia sericata Mg. – 1, Sarcophaga haemorrhoidalis Mg. – 17). The flies were caught on various food products in the bazaar. We isolated 5 dysentery cultures – 2 Flexner type "f", and 3 Schmitz-Shtutser (Table 2). It is of interest to note that at this time, we also isolated type "f" from the feces of patients with Flexner dysentery.

Thus, during the 3 years of work, we isolated from southern house flies 8 typical Flexner strains, 6 Grigor'ev-Shiga, 3 Schmitz-Shtutser, 5 (4 Flexner and 1 Newcastle) from 5 flies belonging to 5 exophilous species, 7 atypical strains giving only a positive partial agglutination, and 79 nonagglutinating cultures.

Unfortunately, the lack of monoreceptors sera in 1953, did not enable us to investigate these 86 strains further, and thus, deprived us of the opportunity to confirm their dysenteric nature.

We turn now to a discussion of the results obtained. The material cited indicates a considerable natural degree of contamination by dysentery bacilli among house flies and the six species of exophilous coprobiontic flies most common in this center of population.

As far as we known, the literature contains no information on the finding of dysentery microbes in

the exophilous species investigated in Central Asia, although, there are a number of indications that dysentery microbes can be transmitted by certain species of this group, particularly, the members of the genera Fannia, Muscina, Calliphora and Sarcophaga [Zmeev, 1944a, 1944b; Loritz, Francis, Makara – cited by Zmeev] and others.

We will analyze our finds from the viewpoint of the biology and ecology of these 6 species of flies in this particular inhabited locality. In Central Asia, F. canicularis, L., F. scalaris F., Muscina stabulans Filln. and Callpihora erythrocephala Mg. are umbraphilic species, and, in accordance with this, have two seasonal peaks (spring and autumn). Their polyphagous larvae develop in fecal masses in latrines, occasionaly in single pats of feces, in waste food dumps, in pig and hen dung, while Calliphora erythrocephala Mg. also breeds in the carcases of various animals, including dead silkworm pupae. In February-April and October-December, they have a greater range of habitat, being found in considerable numbers on various products exposed for sale in the bazaar, as well as in refuse in its vicinity. In spring they appear to replace the southern house fly, which attains its maximum numbers in June.

In May-June, the numbers of umbraphilic species in open localities are greatly reduced owing to the high temperature, low relative humidity and increased insolation.

But, the curves showing the daily course of the activity of the remaining population acquire a two-peak character with a morning and evening peak, when the flies warm themselves in the sun and visit products on sale on the sunny side of the bazaar. In the daylight hours, they conceal themselves in various shaded shelters and in vegetation where they are capable of spending 8-10 hours.

Thus, in spring and autumn, they can pick up considerable numbers of bacteria from the surroundings of the bazaar and transmit them to products during the entire day, while in summer, their role consists mainly in the contamination of vegetation and the surface of the shelters. The small number of Muscina stabulans Filln., which we studied over the whole season to a certain extent, bears out this interpretation.

From 42 plants inoculated, with emulsions of M. stabulans, we isolated 9 strains during the 2 years. Four of them (Nos. 18, 52 and 2 nonagglutinating) were found in flies caught in March, April and the first half of May, on currants and cakes on sale in the bazaar, while 3 (nonagglutinating) were isolated from flies caught on vegetation at the end of August. At the beginning of November, however, we obtained 1 culture from a fly which had been "sitting" on a cake.

We also note that strains No. 2 and No. 21 were isolated from F. canicularis L. and Calliphora erythrocephala Mg., caught in spring on sweetmeats in the bazaar, while strain No. 123 was obtained from F. scalaris F. found on a tree trunk there, early in the morning of June 22.

As a result of our investigation of thermophilic exophilous species of flies, it was found that those having the greatest epidemiological significance in summer in this center of population are Musca sorbens Wd., M. osiris Wd., M. larvipara Portsch, and Sarcophaga haemorrhoidalis Mg. These 3 species of the genus Musca are most abundant and most active in the hottest daytime hours of June-September, when S. haemorrhoidalis Mg. shelters from the direct sunlight for a short period. M. sorbens Wd. and S. haemorrhoidalis Mg. breed in vast numbers in the single pats of feces scattered on the ground near the bazaar. They often and repeatedly come in contact with them and with the market products, to which they can transmit pathogenic microbes of the enteric group.

For instance, in an investigation of 39 specimens of S. haemorrhoidalis Mg. caught in the bazaar in April-October, we isolated 1 Newcastle strain (No. 325) from 1 male crawling over grapes (September 25), and 2 nonagglutinating strains, resembling the Flexner bacillus in biochemical properties, from 1 female crawling on khalva (April 25), and 1 male caught on a table at which ice cream was being eaten (October 6).

From 19 specimens of the bazaar fly (Musca sorbens Wd.) investigate in July-September, we obtained in August, besides strain No. 231 (Table 3), another two nonagglutinating strains, of which one was biochemically similar to the Flexner bacillus, and the other to the Grigor'ev -Shiga bacillus. The first of these strains was isolated from a fly caught on granulated sugar, and the second from a fly crawling on currants.

Although M. osiris Wd. and M. larvipara Portsch. are pasture flies, breeding mainly in cow droppings, these species are carried into the bazaar in considerable numbers on asses, horses, goats, sheep and cattle, driven in

for sale. Here the flies can be easily contaminated with pathogenic microbes and transmit them to products, since they also frequent fecalia and occur on various fruits and sweetmeats.

Unfortunately, we investigated only 2 specimens of M. larvipara Portsch. and 6 specimens of M. osiris Wd., but, nevertheless, from 1 specimen of the first species caught on cakes in the bazaar, we isolated a culture of Gram-negative, nonmotile bacilli, which gave a delicate growth on an agar slant and fermented glucose, mannitol and saccharose without gas formation. Similar cultures were obtained from 2 plates inoculated with emulsions of 2 specimens of M. osiris Wd. caught in March and July from cakes and currants.

The transmission of dysentery bacilli from fecal mass to products is even more likely in the case of the southern house fly (M. d. vicina Mcq.). In Central Asia in summer it leads a predominantly exophilous mode of life, and breeds here not only in accumulations of cattle dung and in waste food heaps, but, even in fecal masses wherever they may be found. Simliar informations was given by Shura-Bura [1951] for the southeast part of the Crimea.

In 1953, the seasonal increase of dysentery and other gastrointestinal disease (enterocolitis, gastroenterocolitis, simple dyspepsia) was observed in this locality in the period between the last third of May and the 2nd ten days of July, coinciding with the seasonal maximum numbers of the southern house fly.

We see from Tables 2 and 3 that this was not a simple coincidence, since, out of the total number of 17 dysentery cultures isolated from house flies, 13 were obtained in May to mid-June. At this same period, we found the greatest numbers of the typical strains which we obtained (8 from the house fly and 3 from flies of 3 exophilous species – Table 2).

In July, there was a sharp decrease both in the numbers of flies, and in the incidence of gastrointestinal diseases, especially dysentery, due to the widely applied therapeutic and prophylactic measures, including an intensive campaign against the winged flies. Apparently, as a result of this, as well as of the high air temperature, which suppresses the development of dysentery microbes, we found in July only 3 typical dysentery cultures, in house flies caught in the hospital (Nos. 166, 174, 177), in spite of the considerable number of investigated flies collected in different places (502 specimens inoculated onto 132 plates).

Although the regular investigation of house flies was continued until mid-November, we did not isolate any more typical or atypical strains (giving only a partial agglutination reaction).

In August there was a sharp increase in the contribution of nonagglutinating strains (30 strains from M. d. vicina Mcq., 5 from exophilous species of flies and 1 from a large hornet), which coincided with a marked reduction in the percentage of typical cultures obtainable from feces of patients. It should be noted that in 1953 and 1954 we did not observe a second (autumn) rise in the dysentery curve.

The results given above, as also the fact of the isolation in 1955 of Flexner type "f" cultures from flies and from feces of patients, indicate a definite parallelism between the microflora of flies and the intestinal microflora of patients. This is also borne out by the results of other authors [Pavlovskii and Bychkov-Oreshnikov, 1937; Zmeev, 1944a, 1944b).

Even if we assume that the 79 nonagglutinating strains which we isolated are lactose-negative variants of the colon bacillus, our findings still show that in this center of population there is a considerable fecal contamination of the environment, and hence, a great possibility of the transmission of agents of alimentary infections by various species of flies.

A number of authors [Kalina, Rybas and Somova, 1952; Korshakova, Sekreta, Mikulinskaya, and Levin, 1953] showed that in the period of transition from acute dysentery to chronic dysentery, lactose-negative nonagglutinating bacilli were isolated from the intestines of patients, and that a high external temperature reduced the cultivability of the dysentery bacillus and led to the isolation of atypical microbes from the patients.

On the other hand, Al'tgauzen [1954] demonstrated that dysentery bacteria could be modified in the gut of the house fly up to a complete loss of agglutinability by the corresponding antisera.

In the light of the above-mentioned studies, the 79 nonagglutinating cultures which we isolated from flies assume diagnostic interest and stress still more the serious role of the fly factor in the transmission of dysentery, especially when insanitary conditions prevail in centers of population and sick people – the vectors of dysentery

bacteria – are present. Of course, we do not by any means deny the role of contact, water factor, "dirty hands" factor and other modes of spreading dysentery.

SUMMARY

As a result of bacteriological investigation of various species of syanthropic flies from March to November 1953, 1954 and 1955 in one of the centers of population in lowland Uzbekistan where there is a high incidence of dysentery, it was found that the seasonal (June) rise of the dysentery curve was correlated with the seasonal maximum of numbers of Musca domestica vicina Mcq. in June, when the greatest numbers of typical dysentery strains were cultured from flies caught in the bazaar and in latrines.

As far as we can judge from our small amount of material on exophilous species of flies, the thermophilic species of Musca sorbens Wd. and Sarcophaga haemorrhoidalis Mg., which are most numerous in summer, can transmit dysentery bacilli from fecal masses to products where they are exposed for sale at this time of the year.

In spring, the umbraphilic species Fannia canicularis L., F. scalaris F., Muscina stabulans Fiin. and Calliphora erythrocephala Mg., having spring and autumn maxima, would appear to replace the house fly in open localities both in numbers and in epidemiological relation.

In view of this, for dysentery prevention it is essential to take measures not only against the house fly, but, against the whole complex of the most widespread synanthropic flies, by modifying the method of control in relation to the season and the changes in the species composition and mode of life of the flies.

For a thorough clarification of the epidemiological role both of house flies and of different species of the exophilous group in the spread of dysentery over the whole season, there should be a regular, large-scale investigation of natural contamination by dysentery microbes in centers of populations in different landscape and climatic zones.

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SYNANTHROPIC DIPTERA OF THE YUGOR PENINSULA AND VAIGACH ISLAND

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The present paper is the result of an examination of material collected on Vaigach I. and Yugor Peninsula between May and August, 1957.

Advice and help in identifying the species were received from A. A. Shtakel'berg and B. B. Rodenford, and the author expresses his sincere thanks to them for this.

The literature contains very little information on synanthropic dipterans of the tundra zone. The species composition of synanthropic flies in the Arctic can be gaged only from some faunistic lists of dipterans of the tundra zone. The majority of these works pertain to the beginning of this century, and naturally, these results must be approached with great care.

Meijiere [1910] lists 10 species of Calliphoridae for the Arctic. There is some information on flesh and coprophagous flies in the region of the R. Mezen [Lundström, Frey, 1913], the Lena mouth [Frey, 1915] and the R. Kara basin [Becker et al., 1915]. However, published data on the association of these species with the cultivated landscape of the tundra zone or of their relation to human dwellings is very sparse. For instance, in a recent survey of the synanthropic dipterans of the USSR, A. A. Shtakel'berg [1956] observes that, as regards the Far North of the USSR, even the species composition of the synanthropic dipterans is unknown.

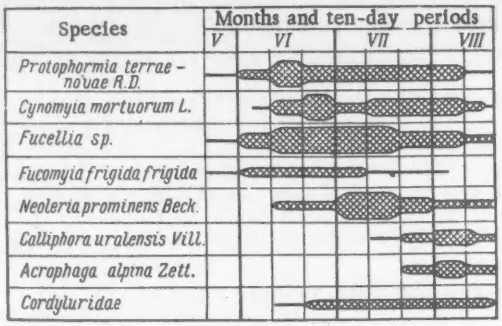
We must bear in mind that the tundra zone lacks a whole series of structural units which constitute a cultivated landscape, owing to the absence of settled cattle-rearing and tillage, and there remain only buildings with their surrounding grounds.*

We conducted our observations in the town of Amderma, in the settlements of Khabarovo, Vaigach and Varnek, in the region of Cape Bolvanskii, at three polar stations and around the industrial huts on the shore of the Barents Sea, 50 km south of the strait. Thus, our route passed through two subzones (Arctic and moss-lichen tundras); in addition, 30–40 km south of Khabarovo, there is distinct shrub tundra with Salix lanata predominating, and still further south the percentage of the land covered by continuous willow groves reaches 70%.

Investigations showed that in this region the following species were most closely associated with the cultivated landscape: Cynomyia mortuorum L., Protophormia terrae-novae R. D., Calliphora uralensis Vill., Acrophaga alpina Zett., Froncilia fusipalpis Zett., Protocalliphora sp., Abonesia genarum Zett., Boreelus atriceps Zett., Musca domestica L., Fucellia sp., Neoleria prominens Beck., Fucomyia frigida frigida var. parvula Haliday, Eristalomyia tenax L. and several species of Cordyluridae (Scopeuma squalidum Meig., S. obscurinerve Beck., S. septentrionale Beck. and others). The majority of these species can be considered as true synanthropic species.

Of the synanthropic flies of Yugor Pen. and Vaigach I. the Calliphoridae come first as regards numbers of species, abundance, and closeness of association with human habitation. Cynomyia mortuorum, Protophormia terrae-novae and Calliphora uralensis are the most abundant of them.

*In defining the concept of a cultivated landscape, we agree with the views expressed by Yu. G. Saushkin [1951].



Seasonal fluctuations in numbers of synanthropic flies in the region of the north Yugor Pen. and the southern part of Vaigach I.

These species are common synanthropes in the more southerly regions also, and are widely distributed throughout the whole forest zone of the USSR. Of these species, the most abundant synanthrope in the forest zone is Protomorphia terrae-novae. Cynomyia mortuorum is of no great importance in the complex of synanthropic dipterans in most regions of the central zone, but in the region investigated this species together with P. terrae-novae constitutes the basic fauna of synanthropic flies. Calliphora uralensis is rather less numerous here, than the two previous species. This species is most clearly associated with human habitation and is rarely found in the natural landscape. The larvae of C. uralensis develop mainly in fishery refuse.

The other members of the Calliphoridae include typically Atctic species (Acrophaga alpina, Froncilia fuscipalpis, Abonesia genarum, Boreellus atriceps). All these species are associated to a lesser degree with human habitation and B. atriceps and F. fuscipalpis, which occur as solitary specimens, can only be reservedly considered as synanthropes. The most numerous of them is A. alpina.

Besides the calliphorids, flies of the family Helomyzidae are very common among the synanthropic species. They appear to be represented mainly be Neoleria prominens, which is particularly numerous in latrines.

It is of interest that in this region in 1955, there was an outbreak of hoof-and-mouth disease with a very high mortality of reindeer. The numerous corpses of fallen deer naturally served as a very suitable substrate for the breeding of flesh flies. All the carcasses were literally teeming with larvae of Cynomyia mortuorum, Protophormia terrae-novae and Neoleria prominens. In all probability, the extremely high numbers of these species observed in 1957, can be attributed to the presence of this substrate for the development of the larvae.

The close contact of these species with corpses compels us to take careful regard of them during a hoof-and-mouth epidemic, particularly in view of the fact that at high latitudes, where the processes of decay proceed very slowly, the hoof-and-mouth virus may retain its viability for a very long period. In any case, there are indications that at low temperatures and with retarded decomposition of the corpse the hoof-and-mouth virus survives for a month instead of the usual 12-14 hours.

An interesting fact, is that the Neoleria prominens larvae in the carcases were in an active state long before the snow melted. For instance, in the early days of June, in corpses which had just appeared from under the snow, we found large numbers of active larvae of different instars and pupae of this species.

Musca domestica was found in small numbers and only in Amderma. It is evident that the Arctic conditions do not allow its wide distribution among the inhabited localities of the tundra zone. Its distribution here was associated only with fairly large settled areas.

As regards the Muscidae, the genus Fuciella, which is very numerous throughout almost all the tundra landscapes, is of interest. The representatives of this genus are particularly numerous on pebbly spits – on rotting algae. In view of their abundance and their association with rotting material they are of constant occurrence in large numbers among buildings and in dwellings; nevertheless, we cannot call them true synanthropes, since their abundance in the cultivated landscape is due to the high total numbers of species of this genus.*

*It is possible that the overwhelming majority consists of one species.

Common in bulidings are the peculiar stumpy flies of the family Coelopidae (Fucomyia firgida frigida var. parvula). The other variety F. fr. fr. gravis Haliday is rarely found in houses, and occurs mainly among rotting algae on pebbly spits.

Cloesly associated with human feces are many species of the family Cordyluridae, which is very richly represented in the tundra zone.

An interesting find was that of Eristalomyia tenax in the grounds of a polar station. This cosmopolitan has not hitherto been found within the Arctic Circle.

No special quantitative survery of synanthropic dipterans were undertaken, but the results of daily observations enabled us to represent on a diagram the seasonal variation in numbers, using a four-point scale; the fine line means that the species was found as single specimens, and the widest band denotes that the species occurred everywhere in large numbers (see figure).

On examining the distribution of synanthropic flies within the indicated subzones we find an increase in the degree of association of species with the cultivated landscape on progression northward from the shrub tundra. For instance, in north Vaigach, in the Arctic tundra region, the majority of species are hardly found at all outside the cultivated landscape, while in the shrub tundra region only C. uralensis is very closely associated with human settlements. We cannot fail to see here a repetition of the general pattern of the zonal distribution of synanthropic dipterans: an increase in the degree of association with human habitation in northern latitudes as compared with more southern, where there is a greater dispersion in nature [Shtakel'berg, 1955].

Thus, in the investigated region of the tundra zone C. mortuorum, P. terrae-novae, C. ualrensis, and N. prominens predominate in numbers among the synanthropic species of Diptera. The first three species are typical forest species as regards geographical distribution; in their extension into the tundra zone, they do not decrease in numbers (C. mortuorum is even more abundant in the tundra zone than in most regions of the forest zone). Thus, in its basic composition the dipteran fauna of the cultivated landscape of this particular region of the tundra zone largely repeats the features of that of the forest zone.

In tha natural zonal landscape, we can establish a numerical predominance of typically tundra species from the example of any groups of species, as we did in the case of Syrphidae [Chernov, 1959].

This situation can to a certain extent be explained by the brief historical age of the cultivated landscape of the tundra zone. At the present time, features of a typical tundra complex of synanthropic flies have not yet been developed, though many species reveal a tendency toward synanthropism.

Thus, with cultivation of the tundra landscape, we find, on one hand, a northward movement of synanthropic species, the contribution of which is greater, the greater the degree of cultivation of the given territory (for instance, Musca domestica member of the complex of synanthropic dipterans only in such large settlements as Amderma), and on the other , the appearance of new synanthropic species from among the typical tundra species.

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THE ANTLER-BUD FLY BOOPONUS BOREALIS SP. N. (DIPTERA, CALLIPHORIDAE) – A NEW PARASITE OF THE MARAL (CERVUS ELAPHUS SIBIRICUS SEV.) IN SOUTHERN SIBERIA

B. B. Rodendorf

In summer of 1958 I received from Prof. K. P. Andreev, for identification, some parasitic Diptera, the larvae of which live in the skin of the young antlers of the maral in southern Siberia.

This material was collected in summer of 1957 by A. N. Tikhomirova, the chief veterinary officer of the Us Maral-Rearing State Farm. I received egg batches and numerous newborn larvae, fully grown stage III larvae numbering 16 specimens, 10 specimens of puparia and winged insects comprising 2 males and 5 females. All the material was fixed in formalin and contained in three specimen tubes. The egg batches (fly "spit") were removed from the antler buds on June 24. The fully grown larvae were taken from the soil on July 1 and produced winged insects on July 20.

The Us Maral-Rearing State Farm of the Ermakovskoe district of Krasnoyarsk territory is situated in the basin of the R. Us, a right tributary of the upper Yenisei, in the eastern spurs of the western Sayans.

As an investigation showed, the antler-bud fly belongs to the Calliphoridae, subtribe Auchmeromyiina and genus Booponus Aldrich 1923. It is most closely related to the musk deer fly, Booponus inexspectatus (Grunin) which is found in the Primor'e Territory and, apparently, in Mongolia. The antler-bud fly is a peculiar species of this genus, which is distributed in southeast Asia.

Booponus borealis Rohdendorf. sp. nova.

Imago. Head equal in breadth to thorax. Width of frons level with base of antennae equal to 0.42 of head width in male, 0.40-0.44 in female, between upper angles of eye in male 0.38, in female 0.36-0.41. Third antennal segment in female 2.9, in male 2.8-3.4 times longer than 2nd segment. Arista a little longer than 3rd segment, swollen to apical fourth (male) or to apical third (female). Hairs on arista prominent only on its upper-side, their length not exceeding the thickness of the arista; on underside of arista the hairs are barely discernible on its apical half. Buccae very broad, their height exceeding half height of eye. Parafacials narrow, entirely covered with black bristles. Frontal median stripe very broad; sides of frons do not exceed $\frac{1}{5}$ width of frontal stripe. Frontal bristles stout, numbering 7-10 pairs, directed inward; hindmost pair bent forward. Ocellar bristles stout, projecting sideways and slightly forward. Inner and outer vertical bristles present in both sexes. Orbital bristles also present in both sexes. Proboscis short, palps strongly swollen at ends. Vibrissal carinae covered with short black bristles right to middle; row or three rows of bristles on carinae below, one row above. Vibrissal angles with a group of bristles, of which 2-3 are particularly long. Buccae with black bristles, their hind surface with pale hairs.

Thorax. Ac 3 + 3, postsutural bristle displaced back; dc 3 + 4; hum 3; ph 3-2, the outermost bristle very weak; ia 1 +3, presutural and first postsutural bristles very weak. Propleura, bare, pronotum with pale hairs, stpl 1 + 1; ptpl with 2 long and 4-5 short bristles. Claws short in both sexes. Legs with black bristles. Section of vein r_{4+5} from base to cross-vein, rm, almost entirely convere with bristles. Scutellum with numerous bristles on margin.

Fig. 1. Booponus borealis Rohd., sp. n. Male genitalia from side.

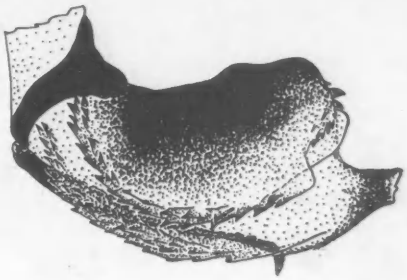

Fig. 2. Booponus borealis Rohd., sp. n. Phallus from side.

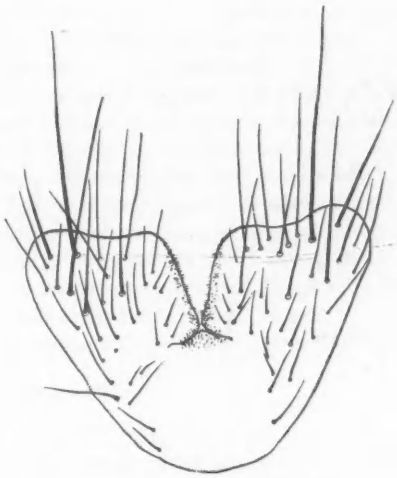

Fig. 3. Booponus borealis Rohd., sp. n. 5th abdominal sternite of male.

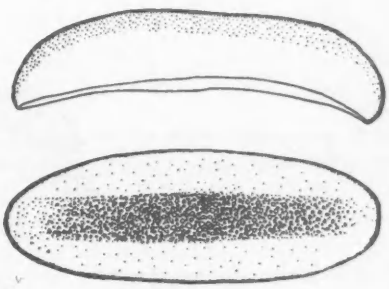

Fig. 4. Booponus borealis Rohd., sp. n. Egg from side and above.

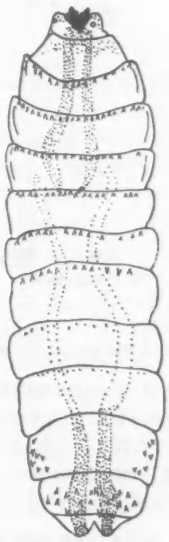

Fig. 5. Booponus borealis Rohd., sp. n. Stage I larvae, dorsal view.

Abdomen obovate, devoid of long bristles, male genital appendages small (Fig. 1, 2, 3).

Coloration. Ground color pale yellow. Head and its appendages yellow. Arista and 3rd antennal segment, except base, black. Ocellar triangle and vertex somewhat darkened. Parafacials and sides of frons with sparse but clearly discernible silvery bloom. Thorax darkened; prothorax, propleura, humeral calluses, notopleura, sides and hind margin of mesonotum behind suture, scutellum and hind parts of pteropleura and sternopleura yellow. Mesonotum covered with grey bloom, forming a pattern of longitudinal stripes – five in front of suture and three behind suture. Legs and squamae entirely yellow. Wings transparent. Male abdomen entirely yellow, in female hind margin of 2nd, 3rd and 4th tergites on sides with contrasting, sharp, narrow, dark, hind-marginal rims. Genitalia pale yellow, phallus contrastingly black.

Fig. 6. Booponus borealis Rohd., sp. n. Stage I larva, front end from above.

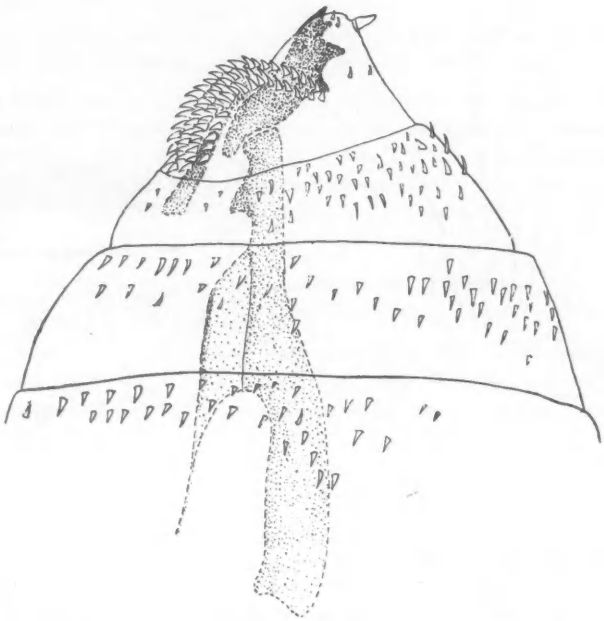

Fig. 7. Booponus borealis Rohd., sp. n. Stage I larva, front end from side.

Body length of male 6.0, female 5.5 mm.

Egg (Fig. 4) of elongate-ellipsoidal form, with both ends of approximately the same curvature. Upper surface of chorion convex, much thicker than fine membranous, lower surface, which is flatter. Along the upper side of the egg, there is a longitudinal sculptured stripe, consisting of angulate, irregular cells; this stripe is roughly parallel-sided. Egg not pigmented, pale yellowish. Length of egg 0.901-0.944, width of egg 0.272-0.300, height of egg 0.200, width of sculptured longitudinal stripe at middle of egg 0.128-0.130 mm.

Larva. First stage larva (Fig. 5), newborn, just emerged from egg. Its length appreciably smaller than egg and equal to 0.701-0.715 mm, greatest thickness about 0.2 mm. Body segments covered in places with short and rather stout, straight spinules. Pseudocephalus (Fig. 6, 7) with sparse and irregularly situated spinules, with a pair of protruding, small, hemispherical sensoriae (antennae), a pair of large combs of preoral teeth in the form of semicircular serrations and with the closely adjacent, projecting ends of the mandibular sclerites of the

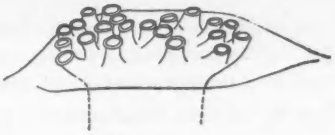

Fig. 8. Booponus borealis Rohd., sp. n. Stage III larva, anterior spiracle.

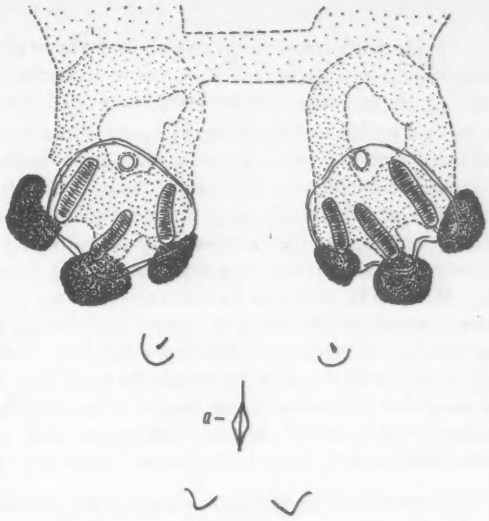

Fig. 9. Booponus borealis. Rohd. sp. n. Stage III larva, posterior end of body, dorsal view. a) Anal spiracles.

cephalopharyngeal skeleton having a peculiar palmate form and bent upward . 2nd body segment narrow in front and broad behind, covered with small spinules in fore half. 3rd segment moderately expanded behind and bearing one row of relatively stout spines on fore margin. Body segments 4-8 of approximately the same shape and size and bearing one row of spines on fore margin. Ninth and, particularly, tenth segment almost devoid of spines on dorsum; there are only very tiny and sparse spinules on their fore margins. Eleventh segment with spines on sides and totally devoid of spines on central part of dorsum. Twelfth segment almost entirely covered with spines; particularly strong spines on its hind margin. The last, 13th body segment, is small, bearing the hind spiracles and often retracted; no spines on it. Cephalopharyngeal skeleton large, its length 0.214 mm. Mandibular sclerites (mouth hooks) separate, but lying close to each other along middle line, curving upward and having the form of a three-or four-toes paw (Fig. 7). There is a basal sclerite supporting the combs of preoval teeth. Remainder of cephalopharyngeal skeleton not distinct and fused into a single whole. Ventral processes of pharyngeal sclerite much smaller than dorsal. Stage I larva unpigmented; only the almost black mandibular sclerites stand out contrastingly.

Stage II larva unknown.

Stage III larva cylindrical, weakly swollen in central part of body. Length 8-10 mm, thickness 2.5-4 mm. Color of fixed larva grey (owing to the covering of dense spines and the gut, filled with host's blood, shining through cuticle). Anterior spiracles (Fig. 8) barely project above surface of body and bear 22-23 tubular orifices. Cephalopharyngeal skeleton with large manibular sclerites constituting almost 0.26 of the length of whole skeleton length of manibular sclerites 0.337, their height 0.200, length of whole cephalopharyngeal skeleton 1.275 mm. Width of fan of anterior spiracles 0.250 mm, length of anterior spiracles, including atrium, 0.350 mm, distance between left and right anterior spiracles, 1.150 mm. Posterior spiracles (Fig. 9) situated above complexly constructed atrium with an irregular annular chamber with three almost black, angularly rounded bodies, situated in lower part of atrium; slits of spiracles indirectly connected with these bodies and lying almost dorsally on sruface of body. Slits placed fanwise, the longitudinal axes of each slit diverging toward lower, ventral side of body and converging upward . Distance between inner slits of both spiracles equal to 0.175 mm, between outer slits 0.525 mm.

Comparison. It resembles Booponus inexspectatus (Grunin, 1947) most closely, but, differs in the broader buccae, smaller number of frontal bristles, wider frons, the arista always thickened to beyond center, and the presence of dark hind-marginal lateral stripes on female abdomen. The stage III larvae differ in the larger number of tubes on the anterior spiracles, which barely project above the cuticle, and the dissimilar lengths of the slits of the posterior spiracles, the outer ones being distinctly larger than the others. The main difference lies in the different mode of life of the larvae, which live in the skin of the young antlers of the maral.

The material used for the description and referred to above is preserved in the Zoological Institute AN SSSR, and includes the type of the species (male imago removed from formalin solution and pinned).

Mode of life and ecology. Apart from the notes given at the beginning of this paper I have no more detailed information about the insect described. K. P. Andreev informed me that the antler-bud fly causes serious damage, considerably reducing the market value of the young horns and thus leading to heavy loss. It would appear that in south Siberia the antler-bud fly has two broods in the course of the year; this is indicated by the rapid development of the pupa and the obtention of winged insects wihin three weeks, by the beginning of the last third of July. It is difficult at present to assume the migration of these flies for hibernation, especially when we consider the highly probable minor role of imaginal feeding, if not complete aphagy of this insect. Special interest arises as to the question of the monophagy of the antler-bud fly, an extremely likely feature and one which would simplify the problem of control of this parasite. We must assume that the collection and destruction of the egg batches ("spit") of the antler-bud fly would be an effective measure; it is possible, however, that such a method of control of this parasite would be difficult in practice. The monophagy of the parasite and its probable limited numbers (of individuals) automatically leads us to suggest the possible effectiveness of biological control by rearing and liberating sterile males obtained artificially by irradiation with suitable doses of x-rays or gamma-rays; I have in mind the successful experiment in the control of the calliphorid Callitroga hominivorax (Coq.) which causes cattle myiasis on the island of Curacao. There is no doubt that a thorough study of the mode of life and development of the antler-bud fly is a very important and pressing problem.

In conclusion we should note the general interest of the discovery of this species. When K. Ya. Grunin first discovered a representative of the genus Booponus on the territory of the USSR, in the Primor'e Territory to be precise, he wrote of the unexpectedness of this find, which enlarged the range of the tropical group Auchmeromyiina and thus revealed the richness of our country's fauna [Grunin, 1947, 1949]. The discovery of the antler-bud fly is even more interesting. While the tropical elements in the fauna of the Primor'e Territory are numerous and perfectly understandable from the very nature of the zoogeographical features of this region, which tends toward the Oriental region, the peculiarities of the fauna of south Siberia, and of the western Sayans in particular, are quite different, and do not connect it with the tropics. The discovery here of a species of a tropical genus is exceptionally interesting. The other species of the genus, apart from the Sikhote-Alin species, which is parasitic in the skin of the musk deer, are distributed in the Phillippines (B. intonsus Ald., – the larvae live in ulcers around the hoofs of the water buffalo) and Burma (B. indicus Aust. and B. aldrichi S.-W., Sm., – the larvae of the first species live in the skin of the elephant). These biological features of the species of Boopnous, particularly their connection with large mammals, still further accentuate the distinctiveness and tropical nature of these calliphorids. At the present time two species of the genus Booponus constitute a special group of Diptera causing myiasis in mammals in the Palaearctic and are, in addition, obligate parasites.

SUMMARY

A description of the adult, egg and larva of a new parasitic fly, Booponus borealis, sp. n., based on the materials collected in southern Siberia (west Sayan mountains) is given in this paper. This species causes myiasis in the skin of young antlers of the Siberian red deer – the maral.

This species is closely allied to Booponus inexspectatus (Grunin, 1947) widespread in the Sikhote-Alin mountains that lives under the skin of the musk-deer (Moschus moschiferus L.). The new species differs from that previously described by broader buccae, exceeding in height one half of eye height, by the presence of dark marginal bands on the abdomen of the female, by a broader frons, by the presence of 22-23 apertures on the anterior spiracles of the mature larva and by certain other characters. The occurrence of a species belonging to the group Auchmeromyiina in Siberia is of great zoogeographical interest.

The injuriousness of this species is great and requires special investigations of its life habits and ecological characteristics so that appropriate control measures might be adopted.

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RESULTS OF THE CHINESE-SOVIET ZOOLOGICAL-BOTANICAL EXPEDITIONS OF 1955-1957 TO SOUTHWEST CHINA

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DERMAPTERA OF SZECHWAN AND YUNNAN

The collection of Dermaptera made by the expeditions in the provinces of Szechwan and Yunnan was very large and was of great interest. It consisted of 86 identified species, not counting about 10 other species represented by only females and identified only to genus. This paper contains descriptions of 1 new subfamily, 4 new genera and subgenera, 31 new species, and 2 new subspecies.

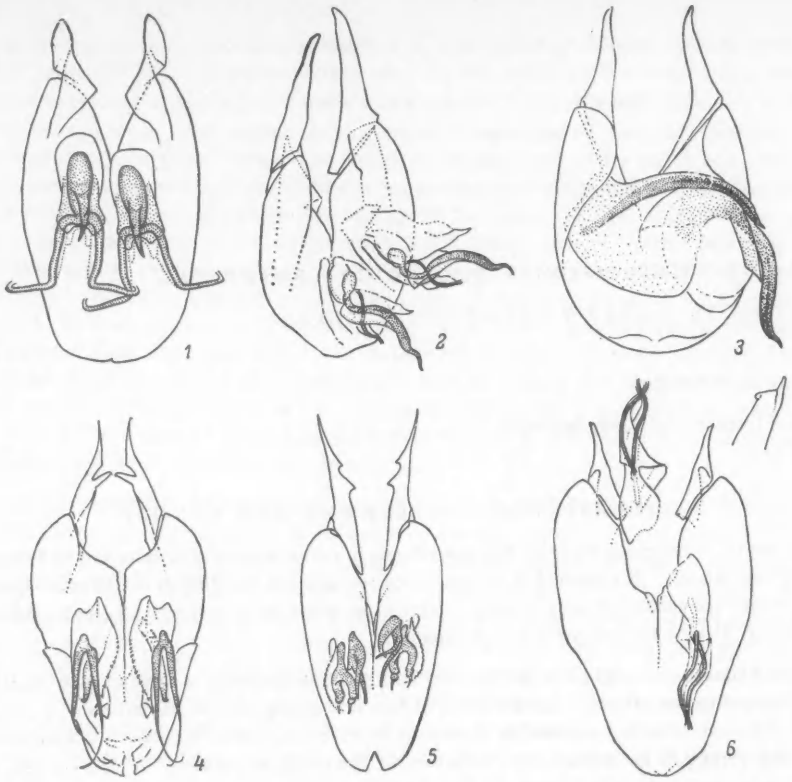
The fauna of Yunnan was found to be particularly rich and was mainly of a tropical Indo-Malayan character. This richness of tropical nature attracted the attention of two outstanding English naturalists – C. Darwin and A. Wallace – who made an invaluable contribution to science by their creation of the theory of evolution. This year, makes the 100th anniversary of the publication of Darwin's "The Origin of Species." In view of this, the author dedicates 2 of the new species described below to this scientist.

Many Chinese and Soviet entomologists and other persons took part in the collection of the material; on the Chinese side – Wang Shu-yung, Ko Ts'ung-ling, Ling Te-ying, Li Ching-hung, Li Ch'i-kuan, Lai Huang-ch'ung, Lui Ta-hua, Liang Ch,iu-cheng, Ou P'eng-jung, P'u Fu-ti, Sai Mao-hsing, Hsueh Yu-feng, Wu Io, Ha Shih-ts'ai, Huang K'o-jen, Huang T'eng-jung, Hu Kao-ch'eng, Hung Kuang-ti, Tsang Ling-ch'ao, Chao I, Chou Peng shou, Ch'a-yun, Cheng Chih and Yang Hsi-chih; on the Soviet side – staff of the Zoological Institute AN SSSR, N. S. Borkhsenius, T. N. Bushchik, A. K. Zagulyaev, O. L. Kryzhanovskii, A. S. Monchadskii and V. V. Popov, and from the staff of the Institute of Geography AN SSSR – D. V. Panfilov.

Collections in Szechwan province were made only in 1955, principally on Mt. Omei (Omei, Shan). The main investigations of the expeditions were concentrated chiefly in Yunnan and covered its central, western, southern and southeast regions, which, apart from the mountainous regions, lie within the subtropical and tropical landscapes.

The following list of the localities of capture of the collection material in Yunnan is subdivided into the four above-mentioned arbitrary geographical regions. This list includes the necessary additions and amendments to the list of geographical localities published previously [Bei-Bienko, 1957].

Center: Kunming, 1900 m above sea level; Hailungt'ang and Wunch'uang near Kunming; Lunan 1770 m; Tungchiafeng, 10 km north of Chingtung, 1000-1300 m; Wuliang Shan near Chingtung, 1800-2400 m. West: Hsia-kuan, 2050 m; Tali, 2100 m and more; Yungping, 1600 m; Paoshan, 1600 m; Nuchiangpa (Salween valley), 800 m; Juili, 800-1100 m; Lungling, 1600 m; Mangshih 900 m; Santai Shan, 30 km southeast of Mangshih, 1200 m; Kaolikung Shan east of Tengchung, 2400 m. South: Chenyuan, 1100 m; Chingku, 930 m; Yuankiang, 400 m; Mokiang, 1300 m; Chianghsitsai, 50 km southwest of Mokiang, 1100-1300 m; Puerh, 1350-1400 m; Szemao, 1300-1500 m; Hsiaomongyang, 750-850 m; 25 km northeast of Cheli; Cheli, 500-580 m; Mongchia, 580-620 m; Shikuyao near Cheli, 650-700 m; Fohai, 1250 m; Nangno Shan near Fohai, 110-1100 m; Tatukang, 1300 m; P'uweng, 900-1000 m; Kanglangpa on R. Mekong, 30 km below Cheli, 450-650 m; Tamonglung, 50 km southwest of Cheli, 550-700m. Southeast: Pingpien, 1400-1600 m; Tawei Shan near Pingpien, 1300-1500 m; Mengtsz, 1350 m; Chinping, 300 m, but nearest hills to 1500-200 m; mouth of R. Nanch'i-Ho, 80-200 m.



Figs. 1-6. Genitalia ♂. 1) Diplatys darwini, sp. n. (type); 2) D. wallacei, sp., n (paratype); 3) D. similis, sp. n. (type); 4) D. popovi, sp. n. (type); 5) D. yunnaneus sp. n. (type); 6) D. bilobus, sp. n. (type).

In the following text, the localities of Szechwan are designated by the letter S., and those in Yunnan by the letter Y. The surnames of collectors have been cited in only in essential cases.

The types of all the described new forms will be handed over to the Institute of Entomology of the Chinese Academy of Sciences in Peking; paratypes will be sent there also and the Zoological Institute AN SSSR in Leningrad. All the collection material pertaining to this paper will be distributed almost equally among the Institutes named.

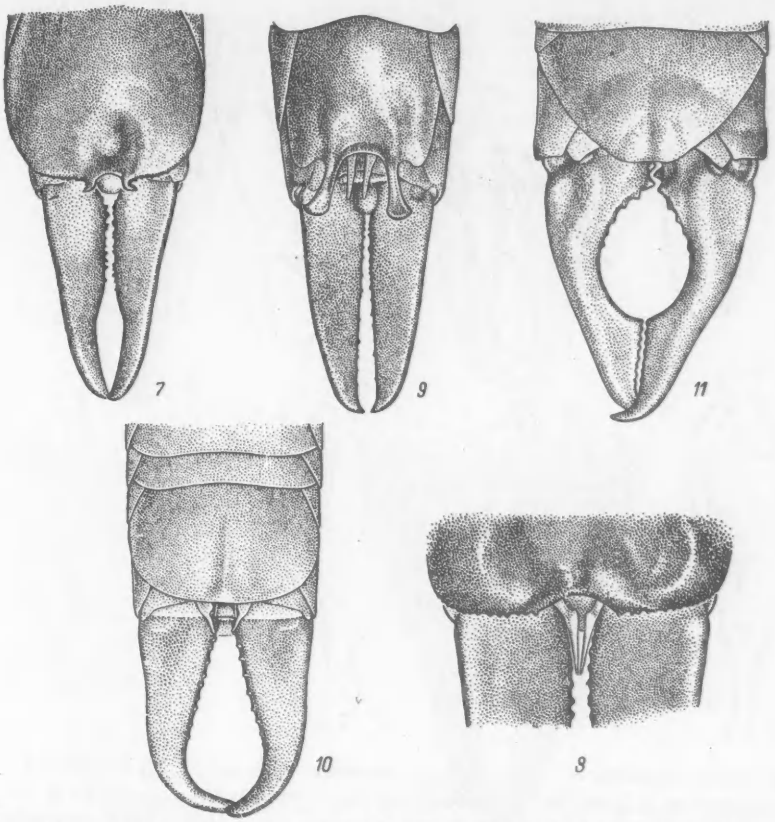
The author is extremely grateful to all the members of the expedition for their active part in gathering the abundant and interesting collection material. He is also specialy grateful to the directorate of the Institute of Entomology in Peking for enabling him to work through a collection so unique in its scientific interest and value.

PYGIDICRANIDAE

Diplatus siva Burr.

Y.: Chinping, 11-15 [V] 1956, 5 ♂♂, 3 ♀♀, some specimens on light.

Hind margin of apical segment of male abdomen has three characteristic excisions and almost agrees with the figure in Burr's work [1911, table VII, Fig. 13a] but, differs in the fact that the two central teeth do not form a slightly projecting median lobe. Later, this hind margin was illustrated twice [Hincks, 1947, Fig. 3; 1955a, Fig. 67], but, these drawings differed from the above and also from one another. However, the characteristic genitalia of this species, figured in Hinck's monograph [Hincks, 1955a, Fig. 66], leave no doubt that our series belongs to this species. The differences in the structure of the apical sternite of the male may indicate a sub-



Figs. 7-11. End of abdomen ♂, ventral aspect. 7) Diplatys popovi, sp. n. (type); 8) D. denticulatus Hincks (Nuchiangpa); 9) D. bilobus, sp. n. (type); 10) Protolabis aroliata, gen. et sp. n. (paratype, Chingtung); 11) Cranopygia yunnanea, sp. n. (type).

specific differentiation of this species, the range of which extends to northeast Burma and the eastern Himalayas. It is recorded from China for the first time.

Diplatys chinensis Hincks

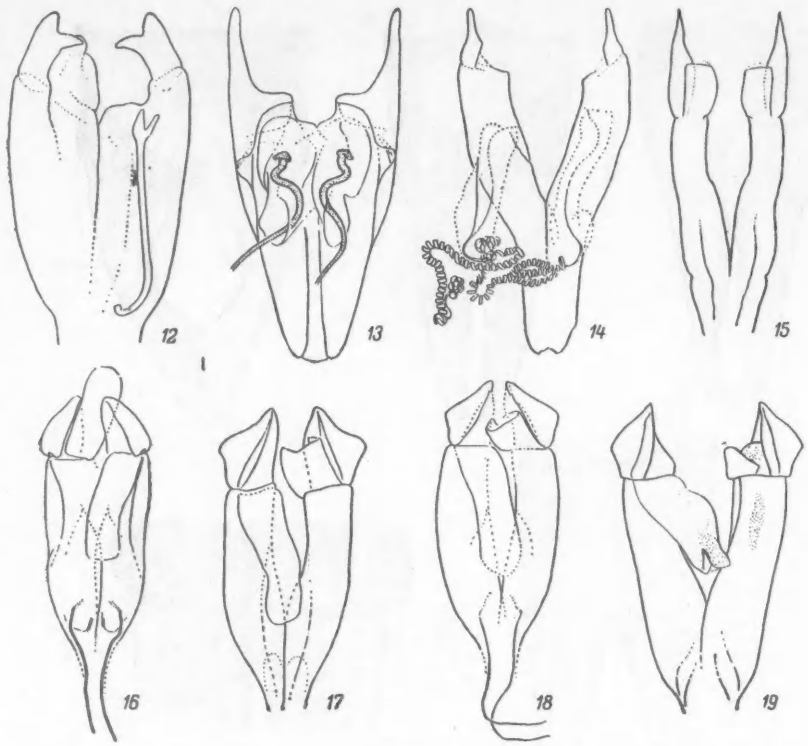
S.: Omei Shan, 600-1000 m, 23 [VI] 1955, 1 ♂.

Recently described from Szechwan [Hincks, 1955a]. In the form of hind margin of apical sternite of male abdomen it is very similar to D. siva Burr.

Diplatys darwini, sp. n (Fig. 1).

Yunnan: Tawei Shan near Pingpien, 30 [VI] 1956, 1 ♂ type, on light (Huang K'o-jen).

♂. Externally, in color and structure of genitalia very similar to D. siva Burr. Rufous-brown. Head with dark brown lateral regions on the occiput, eyes equal in length to genae. Antennae 16 (?)-segmented, brownish yellow. Pronotum small, of equal length and breadth, distinctly but, gradually converging caudad, lateral margins almost straight, hind margin slightly rounded. Tegmina unicolorous, wing-scales darker. Legs yellow, unicolorous. Abdomen cylindrical, not dilated toward apex, invested with fine decumbent hairs and sparser bristles. Last tergite normal. Apical sternite quadrangulate, scarcely elongate, hind margin straight, transverse, only at hind



Figs. 12-19. Genitalia ♂. 12) Cranopygia yunnanea, sp. n. (type); 13) Echinosome albisquama, sp. n. (paratype, Hsiaomongyang); 14) Protolabis aroliata, gen. et sp. n. (paratype Tawei Shan); 15) Anisolabis (in sp.) excisa, sp. n. (type); 16) A. (Paralabis) montshadskii, sp. n. (type); 17) A. (Geolotolabis) undata, sp. n. (type),18) A. (G.) cheni, sp. n. (type); 19) A. (G.) panfilovi, sp. n. (type).

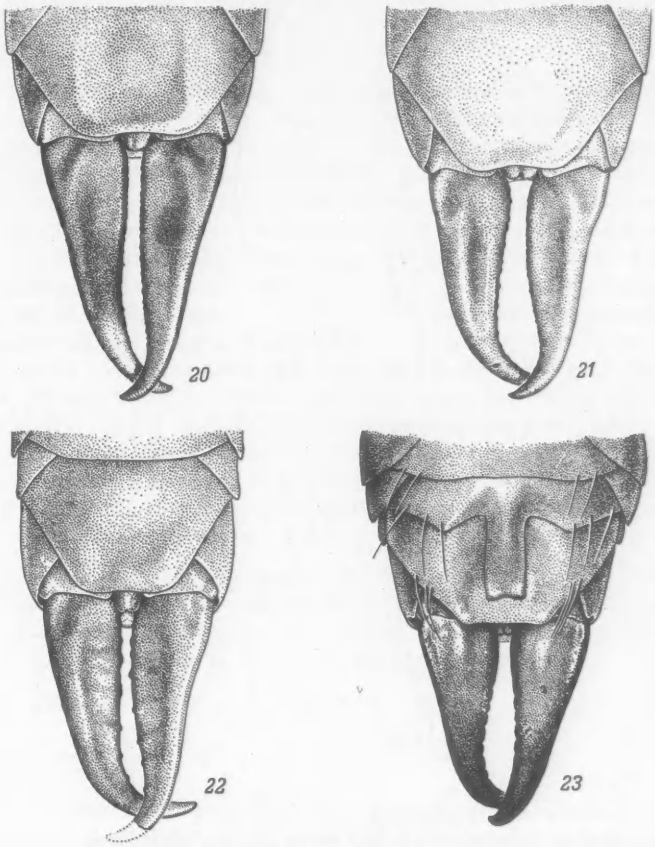
lateral angles does it project slightly in the form of a blunt, rounded, very short lobe. Forceps simple, flattened, straight, gradually tapering to tips and slightly incurved and sharp there. Genitalia with stouter and shorter paramers than in D. siva Burr. the inner margin in the apical half being almost straight, without weak arcuate concavity; virga rather long, with elongate-oval vesicle at base, its two branches wide apart, symmetrical, with a sharp spine near the base of inner branch. Body length 11, forceps 1 mm.

This species is easily distinguished from the externally similar members of the genus by the characteristic structure of the genitalia,and the form of the hind margin of the apical abdominal sternite.

Diplatys wallacei, sp. n. (Fig. 2)

Yunnan: Chinping, 1500-1700 m, 12-15 [V] 1956, 6 ♂♂, including type, and 1 ♀ (Huang K'o-jen).

Externally similar to D. siva Burr and most closely resembling D. rufescens Kirby. Brownish rufous, unicolorous, only the tegmina above, except the very base, and the wing-scales, brown. Head of ♂ with large bulging frons and very short, sometimes rugose, occiput, frontal suture indistinct in both sexes; eyes of ♂ a little longer than genae, in ♀ equal to them in length postocular keel weak. Antennae 16-segmented, brownish yellow, 1st segment rufous yellow, in ♂ of same length as genae, in ♀ slightly shorter than them. Pronotum as broad as long, converging weakly caudad, lateral and hind margins very slightly rounded. Legs unicolorous, rufous yellow, or tibiae brownish to some extent. Abdomen of ♂ quite cylindircal. Last tergite normal. Apical sternite in ♂ approximately as broad as long, hind margin with rather strong and comparatively narrow, arcuate median emargination separating two short, rounded, broad lobes; in ♀ triangular, with rather broad rounded apex. Forceps



Figs. 20-23. End of abdomen in ♂ from below. 20) Anisolabis (Gelotolabis) panfilovi, sp. n (type); 21) A. (G.) omei. sp. n. (type); 22) A. (G.) magna, sp. n. (type); 23) Placolabis mira, gen. et sp. n. (type).

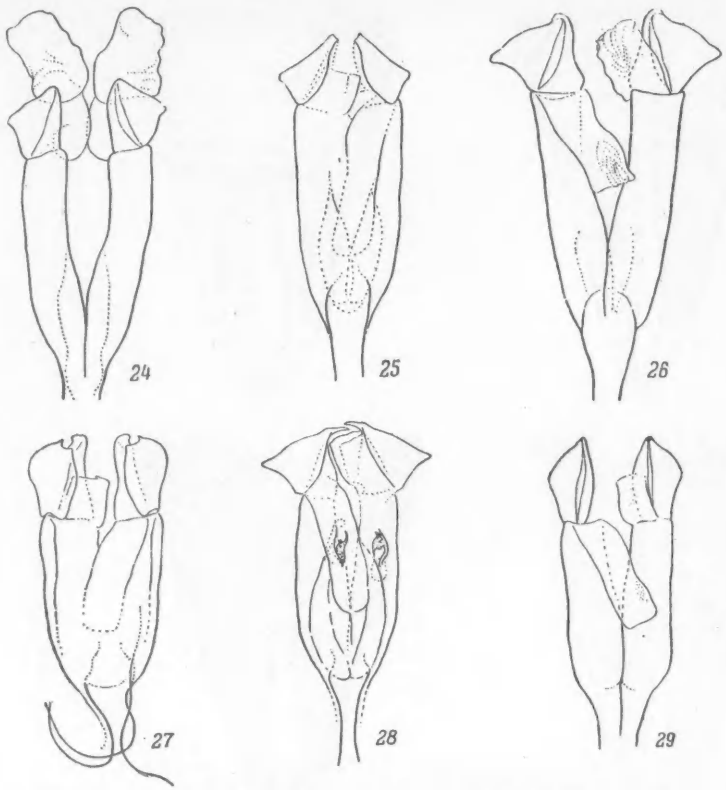
in ♂ simple, straight, slender. Genitalia of ♂ with long, slender, almost straight parameres, not produced at apex; virga of approximately same length as parameres, both its branches sinuate and crossing once at base; base of virga furnished with small, broadly oval vesicle. Body length of ♂ 10-12, ♀ 12; forceps ♂ 1.4-1.7, in ♀ 1.4 mm.

In the structure of the apical sternite of the abdomen the male could be taken for D. rufescens Kirby from the Himalayas. It differs in the more rufous body coloration, the structure of the genitalia, and details of the head structure.

Diplatys similis, sp. n.(Fig. 3)

Yunnan: Chinping, 1700 m 14[V]1956, ♀ on light (Huang K'o-jen).

♂. Externally, in color too, very similar to D. wallacei sp. n., but, differing in the following characters. Body almost entirely more rufous; only the disk of the tegmina brown in apical two thirds. Head with relatively smaller frons and longer occiput, the boundary between them not extending back beyond the line uniting hind margins of eyes. Antennae 18-segmented, yellow. Pronotum very slightly elongate, lateral margins straight, passing into hind margin a little more steeply. Wing-scales of body color. Apical sternite an elongate-quadrangulate, in basal two thirds slightly swollen, then flat, hind margin with broadly arcuate, shallow excision,



Figs. 24-29. Genitalia ♂. 24) Anisolabis (Gelotolabis) omei, sp. n. (type); 25) A. (G.) fallax, sp. n. (type); 26) A. (G.) magna, sp. n. (type); 27) A. (G. ?) externa, sp. n. (paratype); 28) A. (Cerolabis) hwangi, sp. n. (type); 29) Placolabis mira gen. et sp. n. (type).

and from this excision, the straight hind lateral margins extend obliquely outward on each side. Forceps slightly flatter, broader toward base. Genitalia with long, slightly sigmoid parameres. Virga moderately longer than parameres, with one heavily sclerotized arcuate branch; its thickness corresponds roughly to thickness of paramere, but apical part tapers gradually and is sinuate. Body length 12, forceps 1.2 mm.

It is remarkable to find in the same locality and at the same time, three outwardly similar species; the one described, D. wallacei, sp. n. and D. siva Burr.

Diplatys denticulatus Hincks (Fig. 8)

Y.: Nuchiangpa, Salween valley, 11[V]1955, 2 ♂♂, 3 ♀♀.

Recently described from Burma [Hincks, 1957] from a single male; recorded from China for first time.

Most closely resembles D. popovi, sp. n., described below, and forming with it a natural group. The undescribed female is characterized by the following features.

♀ (nova). Externally and in color similar to ♂. Black with light markings. From slightly protruding, indistinctly demarcated from occiput, eyes equal in length to genae, postocular keel distinct. Pronotum with pale crescentic hind part, of equal length and breadth; lateral margins slightly rounded, almost obtuse-angled in center, and hence, pronotum is widest in center. Fore femora dark with pale bases; fore tibiae also dark, but with pale apices; middle and hind femora with dark crossband. Apical sternite of abdomen an elongate triangle with narrow, rounded apex. Forceps yellow, straight. Body length 9.8-10, forceps 1.4 mm.

Diplatys popovi, sp. n. (Fig. 4, 7)

Yunnan: Mangshih, 900 m, 17[V] 1955, 1 ♂ type and 1 ♀ (V. Popov).

Externally similar and in its assemblage of characters very near to D. denticulatus Hincks. Black with pale markings. Head of ♂ with convex frons, fairly sharply demarcated from flat, rugose occiput, in ♀ frons is almost flat, occiput not rugose; frontal suture not visible, eyes in ♂ 1.5 times longer than genae, in ♀ scarcely longer than genae, postocular keel distinct. Antennae pale brown, 1st segment darker and roughly equal in length to genae. Protonum with pale crescentic hind part, extending to lateral margins, in ♂ moderately long, slightly converging caudad, with straight lateral margins, in ♀ as broad as long, distinctly converging caudad, lateral margins passing roundly into hind margin. Legs blackish brown; coxae, base and apex of middle and hind femora pale, remaining parts of intermediate coloration or pale. Abdomen of ♂ cylindrical, only very slightly dilated at apex. Apical sternite of ♂ slightly elongate, hind margin transverse with rounded lateral angles and with two short out-turned hook-like processes in middle, the excision between them only slightly deeper than line of hind margin; under strong magnification the latter reveals very tiny, weak denticles bearing a fine brsitle. Apical sternite in ♀ an elongate triangle with narrowly rounded apex. Forceps in ♂ pale at base, inside in basal half straight serrate and contiguous distally, with a slightly concave inner margin and enclosing here a narrow spindle-shaped space. Forceps in ♀ yellow, straight. Genitalia of ♂ very similar to D. denticulatus Hincks; parameres, long, with sharp, produced apex and long preapical tooth on inner margin; virga in form of a pair of long, slender, slightly divergent branches, filiform in apical half, the less sclerotized plate adjacent to virga is serrate along inner margin. Body length ♂ 11, ♀ 10.5, forceps ♂ 1.5, ♀ 1.4 mm.

The closely related D. denticulatus Hincks lacks the pair of hook-like teeth on the hind margin of apical sternite of male, but, there is a pair of weak projections, undoubtedly homologous to these teeth; moreover, on the hind margin of the sternite in D. popovi, sp. n., we can find under strong magnification weak denticles, very characteristic of D. denticulatus Hincks, but, more distinct in the latter case.

The species is named after Prof. V. V. Popov.

Diplatys liberatus Burr

Y.: Chingtung, 31[V]1956, 1 ♂ on tree trunk.

Externally similar to D. yunnaneus, sp. n. (see below), but differing in the laregr eyes, moderately elongated pronotum, straight hind margin of apical abdominal sternite and the genitalia.

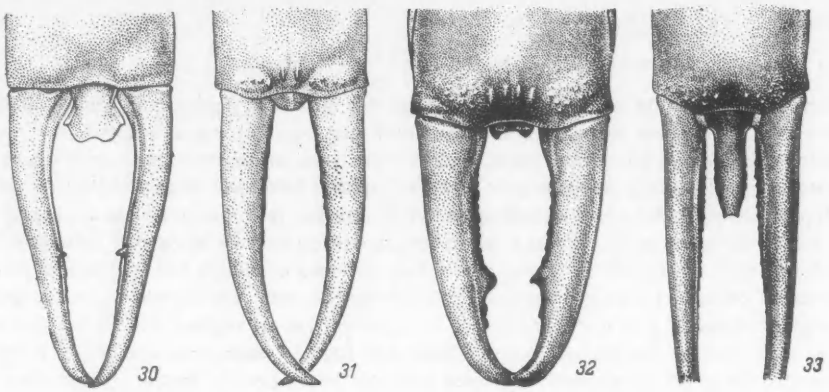
Known from a single male from south Burma; the discovery of this species in Yunnan considerably enlarges its range.

In the structure of the parameres there is a slight difference from the type [Hincks, 1955a, Fig. 127]: the founded emargination under the inner tooth is less distinct in the male from Yunnan.

Diplatys yunnaneus, sp. n. (Fig. 5)

Yunnan: Chingtang, 1250 m, 6[III]1957, 1 ♂ type (D. Panfilov); Tungchiafeng, 2[VI]1956, 1 ♂ (O. Kryzhanovskii); Chenyuan-Chingtung road, 1000 m; 26[IV]1955, 1 ♀ (O. Kryzhanovskii); Chingku, 1000-1120 m, 22[IV]1955; 1 ♀ (Huang T'eng-jung); Cheli, 620 m, 14[IV]1957, 1 ♀ (Wang Shu-yung); mouth of R. Nanch'i-Ho, 200 m, 13[VI]1956, 1 ♂ (D. Panifilov).

Black, small. Head with distinct or weakly marked sutures, eyes in ♂ twice as long as genae, in ♀ approximately equal to them, longitudinal postocular keel in both sexes distinct. Antennae brownish yellow, 1st segment brown, of same length as genae. Pronotum with pale crescentic hind part, extending on to lateral margins, in ♂ distinctly converging caudad, lateral margins at the median bristle barely noticeably projecting at an obtuse angle; in ♀ scarcely wider, barely converging caudad, the lateral margins also with an obtuse-angled projection, but passing more roundly into hind margin, the latter truncate in the center of both sexes. Legs brownish black, the entire coxae and tarsi, bases and apices of middle and hind femora, middle and hind tibiae pale, or middle tibia brownish. Abdomen of ♂ moderately but distinctly dilating toward apex. Apical sternate of ♂ slightly transverse, with a weak impression along center in apical half, hind margin weakly arcuately concave over almost its entire breadth; in ♀ slightly elongate-triangular, flat, narrowly rounded at apex. Forceps pale, in ♂



Figs. 30-33. End of abdomen from above. 30) Apovostox pilosus, sp. n. ♂ (type); 31) Prorues inermis, sp. n. ♂ (type); 32) Adiathetus glaugopterus Borm. f. macrolabia ♂ (Chingtung); 33) A. glaucopterus Borm. var. ♀ (30 km north of Chingtung).

simple, almost straight, the inner margin slightly and very gradually concave. Genitalia of ♂ with long, straight parameres produced to a point at apex, the preapical inner margin with two widely separated teeth; virga shorter than parameres, both branches quite symmetrical, rather stout, a little arcuate inside at apex furnished with short appendages with a fine terminal spine; adjacent to the virga inside are two long, slender, but unequal, appendages, while outside there is a less sclerotized plate invested with tiny denticles on margin. Body length ♂ 8-9.5, ♀ 8.5-10, forceps ♂ 1-1.2, ♀ 1.2 mm.

In coloration, apical sternite and male genitalia similar to D. niligiriensis Hincks from southern India [Hincks, 1955a], but, differs distinctly in the structure of the parameres, virga and adjacent structures.

Diplatys bilobus, sp. n. (Fig. 6, 9)

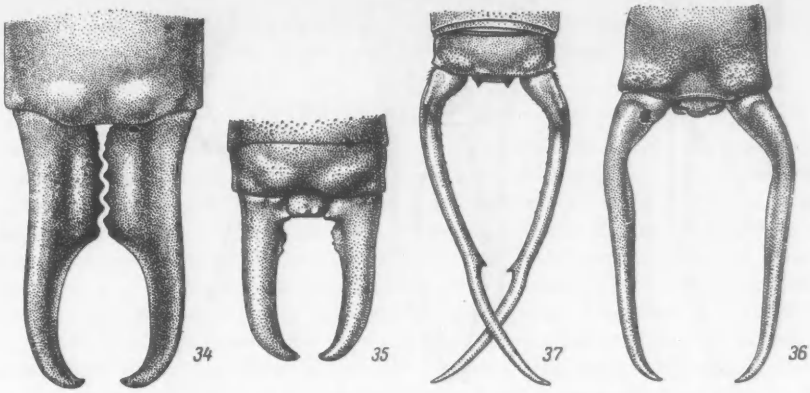
Yunnan: Szemao, 1300 m, 29[III]1957, 1 ♂ type and 2 ♀♀ (D. Panfilov).

Rather large, brown with black markings. Head black with anterior part of clypeus pale, in ♂ with strongly protruding eyes and strongly converging caudad, in ♀ with almost parallel sides behind antennae; frontal sutures in ♂ not apparent, in ♀ replaced by sulci which together form an impressed rectangle. Eyes of ♂ appreciably longer than genae, in ♀ equal in length to them postocular keel distinct and a similar keel extending along lateral margin of genae; occiput in ♂ rugose. Antennae 17 (?)-segmented, yellowish brown, 1st segment brown, in ♀ appreciably shorter than genae. Pronotum black, converging slightly caudad, in ♂ as broad as long, with straight lateral and hind margins, in ♀ slightly transverse, with rounded lateral margins. Tegmina and wing-scales dark brown. Legs dark brown, in ♂ almost black, tarsi paler. Abdomen in ♂ cylindrical. Apical sternite in ♂ quadrangulate, with a pair of long, narrow backward-directed blunt lobes moderately expanded toward apex; in ♀ this sternite is long, broadly lingulate, with broadly rounded apex. Forceps in ♂ dark brown, flattened, straight, simple, in ♀ brownish rufous, less flattened and more slender. Genitalia of ♂ with short but slender parameres, apparently straight, but, in profile slightly arcuate; their apex terminating outside in a short, slender spinule and inside in a very weakly projecting denticle, apical margin obliquely transverse. Virga with a pair of long, slender, slightly helical branches. Body length ♂ 12, ♀ 13, forceps ♂ 1.8, ♀ 2.2 mm.

This species, remarkable in its morphology, is more closely related to D. flavicollis Shir. from Taiwan, being similar also in the structure of the paramere apices. It sharply differs from the Taiwan species, as also from other species, in the very long, distally expanded lobes of the apical abdominal sternite of the male.

Cranopygia yunnannea, sp. n. (Fig. 11, 12)

Yunnan: Chianghsitsai, 1250-1300 m, 31[III]1955, 1 ♀ (O. Kryzhanovskii); Hsiaomongyang, 850 m, 28[III]1957, 1 ♂ type (Tsang Ling-ch'ao); Shikuyao, 650 m, 7[IV]1957, 1 larva (D. Panfilov); Tamonglung, 700 m, 10[IV]1957, 1 ♀ (D. Panfilov).



Figs. 34-37. End of abdomen ♂ from above. 34) Forficula biphaga sp. n. (type); 35) Anechura (Odontopsalis) modesta, sp. n. (type); 36) A. (in sp.) primaria, sp. n. (type); 37) Allodahlia bispina, sp. n. (type).

Brownish yellow with dark abdomen and forceps. Head with shining black mouth parts, hind part of clypeus triangular spot on frons, edges of anntenal pits and a tiny irregular spot on inner margin of eye, hind margin with a narrow, black, irregular rim; eye moderately longer than genae, sutures distinct. Antennae brownish, 33-35 segmented, 1st segment pale yellow. Pronotum as broad as long, greatest width in front of middle, lateral margins arcuate, hind margin truncate,disk with a pair of dark, longitudinal stripes forked in front. Tegmina fully developed, with apical oblique, longitudinal stripe, two stripes along lateral, slightly brownish on outside. Hind and sometimes femora with a pair of brown longitudinal stripes on outside. Abdomen of ♂ moderately dilated toward apex, shagreened. Last tergite moderatly rugose, with longitudinal median, sulcus, hind margin darkened. Apical stenite of ♂ roundly obtuse-angled, with an indistinct sulcus along center in distal half, the hind margin proper, narrow, truncate; in ♀ almost rectangular. Forceps in ♂ moderately flattened, contiguous at very base,thence, constricted, toward center and serrate inside, then slightly expanded, enclosing altogether an oval space; distally with straight serrulate inner margin, apex hook-like. Forceps in ♀ simple. Genitalia of ♂ with short parameres and prepaical tooth, apical process wider and just shorter than tooth, slightly roundly blunt at tip; virga 2.5 times longer than parameres. Body length ♂ 26, ♀ 25-27.5; forceps ♂ 7, ♀ 6 mm.

In structure of forceps and parameres of the male it resembles C. comata Hincks from north Vietnam [Hincks, 1955b], but, differs in the coloration, larger eyes; shape of pronotun, and stouter parameres with shorter preapical tooth.

Cranopygia tonkinensis Hincks

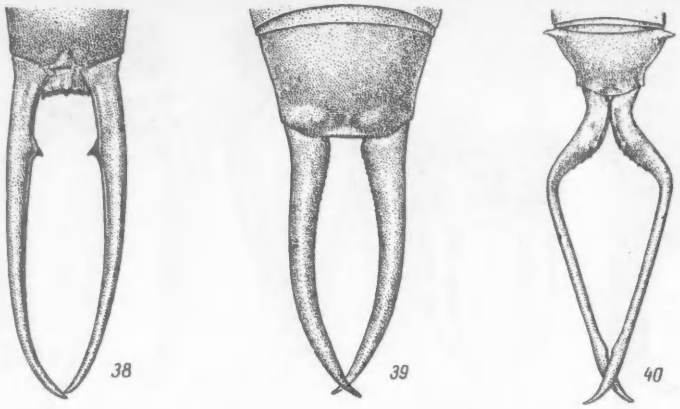
Y.: Chingping, 1600-1700 m, 12[V]1956, 1 ♂, 1 ♀ and 2 late-instar larvae.

Recently briefly described from north Vietnam [Hincks, 1955], recorded from China for first time.

In describing this species, the author mentioned did not refer to the characteristic obtuse-angled excision on the hind margin of the apical sternite of the male abdomen. The parameres are very characteristic and differ slightly from the figure given in the description of this species in the more isolated apical process and the absence of constriction toward the base. Future investigations will show if these differences indicate individual variability, or if the Yunnan specimens belong to a separate subspecies.

Cranopygia modesta Borm.

Y.: Szemao, 29[III]- 5[IV]1957, 1 ♂, 3 ♀♀; Cheli, 12, 31[III]1957, 2 ♂♂, 2 ♀♀; Kanglangpa, 20[III]1957, 1 ♀; Tatukang, 30[III]1957, 1 ♀.



Figs. 38-40. End of abdomen ♂ from above. 38) Kosmetor eurypyga, sp. n. (type); 39) Cosmiola simplex, gen. et sp. n. (type); 40) Cosmicula cornuta, sp. n. (type).

The dark body with pale legs, abbreviated tegmina and the presence of an excision on the apex of the terminal sternite of the male abdomen clearly differentiate this species from others.

Known from Burma, recorded in China for first time.

Echinosoma sumatranum Haan.

Y.: Chingtung and environs, 12-20[III]1957, 14 larvae, 12[V]1957, 4 larvae, 28-29[V]1956, 4 ♂♂, 1 ♀ and 3 larvae under bark, 2-29[VI]1956, 9 ♂♂, 4 ♀♀ under bark; 15 km north of Chenyuan, 26[IV]1955, 2 ♂♂, 2 ♀♀, 2 larvae; Mangshih, 16[V]1955, 1 ♂; Santai Shan, 18[V]1955, 1 ♂, 1 larva; Chianghsitai, 1[VI]1955, 2 ♀♀, 1 larva; Szemao, 11[IV]1955; 2 ♂♂, 5 larvae; Hisaomongyang, 3-5[V]1957, 2 ♂♂, 2 ♀♀, 2 larvae; Cheli and environs, 8-10[IV]1955, 2 ♂♂, 4 larvae, 7-24[IV]1955, 2 ♂♂, 2 ♀♀; Nango Shan, 1[III]1957, 4 larvae; Kanglangpa, 16[III]1957, 1 ♂, 5 ♀♀, 5 larvae, 18[IV]1957, 1 ♂, 3 ♀♀; 30 km southwest of Chinping, 17-28[IV]1956, 2 ♂♂, 2 ♀♀, 2 larvae, 4-22[V]1956, 7 ♂♂, 5 ♀♀, 3 larvae; mouth of R. Nanch'i-Ho, 5-10[VI]1956, 1 ♂, 3 ♀♀.

Widely distributed in the Indo-Malayan region and known also from New Guinea and north Australia. First record on mainland China.

According to the information given, it is represented in March-April partially, or in more northerly localities completely, by larvae, which are found even up till May.

Echinosoma albisquama, sp. n. (Fig. 13)

Yunnan: Hsiamongyang, 850 m, 4[IV]1957, 2 ♂♂, including type, and 1 ♀ (Tsang Ling-ch'ao); Cheli-Tamong-lung road, 600 m, 22[IV]1957, 1 ♂ (Liu Ta-hua); P'uweng, 1000 m, 27 [III]1957, 1 ♂, 1 ♀ (D. Panfilov).

Large for genus, black. Head with distinct sutures, mouth parts dark brown Antennae dark, including 1st segment, only 2nd segment yellowish; segments of apical half slender, almost spindle-shaped. Pronotum unicolorous, strongly transverse, lateral margins widely rounded. Tegmina uniformly black, more asperate than in E. sumatranum Haan. Wing-scales yellowish, unicolorous, standing out sharply against black body. Legs black, only the very bases and apices of tibiae, and the tarsi, yellowish. Abdomen more coarsely punctured in center than at base and apex. Last tergite as in E. sumatranum Haan. Hind margin of apical sternite in ♂ slightly and broadly concave. Pygidium in ♂ large, slightly transverse; in ♀ strongly projecting, lingulate. Forceps in ♂ as in E. sumatranum Haan, but with a distinct denticle on inside near center. Genitalia of ♂ as in E. sumatranum Haan, but basal process more distinct, its fore margin quite perpendicular to long axis of paramere; virga also spirally curved, but only a little more than one turn. Body length ♂ 12.8-15.5, 12-5-16, forceps ♂ 2.8-3, ♀ 3-3.3 mm.

Differs sharply from E. sumatranum Haan in the larger body, basal segment of antenna not being yellow, pale wing-scales, the presence of a median denticle inside male forceps and the genitalia.

PROTOLABIS, GEN. N.

Body bare, flat. Head weakly convex dorsally, as in Anisolabis Fieb., sutures not apparent. Antennae 17-segmented, 3rd segment cylindrical, scarcely longer than 1st, 4th-6th segments not spherical. Protonum dilating caudad. Tegmina fully developed, flat above, revealing at base the triangular scutellum, rounded at apex and not contiguous on inner margin. Wing-scales absent or developed (f. euptera), in latter case not shorter than tegmina. Mesothoracic plate rounded behind, metathoracic plate projecting in the form of a moderately long lobe with rounded apex. Femora short and stout, with no trace of longitudinal keels, all tarsi with a little papilla between claws. Abdomen with subparallel sides. Last tergite quadrangulate, in ♂ with slender keel on sides. Apical sternite of ♂ large, transversely quadrangulate, hind margin broad, slightly convex; in ♀ short, transversely triangulate, apex blunt, narrowly rounded. Pygidium large, vertical, triangular, strongly constricted ventrad, in ♂ with impression, in ♀ flat. Forceps set slightly apart, in basal two thirds straight, then moderately incurved. Genitalia of ♂ with slender, long, straight parameres, dilated toward base and blunt at apex; both lobes of penis directed to one side, with very tiny denticles, virga present.

Type of genus – Protolabis aroliata, sp. n.

Externally, in structure of head and legs, and in the bare body this genus resembles the winged Anisolabis Fieb., but, the form of the tegmina, exposed scutellum, presence of papilla between claws and structure of genitalia leave no doubt that it belongs to the fam. Pygidicranidae. Among the known representatives of the latter, it has no very close relatives, although in the form of the parameres, it is very similar to the genus Echinosoma Serv., but differs markedly, however, in the complex, of the other characteristics. Obviously, this is a representative of a new subfamily combining features of widely separate groups.

PROTOLABINAE, SUBFAM. N.

Body bare, flat. Antennae with less than 20 segments, 4th-6th segments elongated. Pronotum expanding caudad. Femora short and stout, without keels, tarsi with small papilla between claws. Forceps similar in both sexes. Parameres narrow, expanding toward base, blunt at apex.

Protolabis aroliata, sp. n. (Fig. 10, 14)

Yunnan: Chingtung, 1250 m, 13[III]1957, 1 ♂ (D. Panfilov); Szemao, 1500 m, 11[IV]1955, 1 ♀ (O. Kryzhanovskii); Hsiaomongyang, 950m 5[V]1957, 1 ♀ (Tsang Ling-ch'ao); Cheli, 580 m, 9[III]1957, 1 ♂ (P'u Fu-ti); P'uweng, 1000 m, 27[III]1957, 1 ♂, 1 larva (D. Panfilov); Kanglangpa, 540-650 m, 14-16[III]1957, 1 ♂ type and 1 ♀ (P'u Fu-ti, Tsang Ling-ch'ao); Tamonglung, 700 m, 12[IV]1957, 1 ♂ (P'u Fu-ti); Tawei Shan, 1350 m, 27[VI]1956, 1 ♂ f. euptera (D. Panfilov).

Small, black with brown and yellow markings, shining. Head smooth, very finely shagreened, black, mouth parts brown. Antennae brown, unicolorous. Pronotum black, slightly elongate with a distinct convex prozona, and flat metazona, including lateral portions converging at the front, lateral margins straight, hind margin almost straight. Tegmina black, twice as long as pronotum, without lateral keel, disk elongate-oval. Legs brownish yellow or with brown femora. Abdomen very finely shagreened, without lateral tubercles, black with an admixture of reddish brown, especially in apical part. Last tergite with straight hind margin and in ♀ with distinct granules there. Forceps rather stout, gradually tapering to apex, the inner side with tiny denticles below, on upperside of base one denticle in ♂, several in ♀. Body length ♂ 6-7, ♀ 6.5-9, forceps ♂ 1.2, ♀ 1.5-1.8 mm.

LABIDURIDAE

Anisolabis (in sp.) excisa, sp. n. (Fig. 15)

Szechwan: Omei Shan, 1200 m, 22[VI]1955, 1 ♂ type (O. Kryzhanovskii).

♂. Small, shining black. Head with indistinct, but discernible, frontal sutures. Antennae 16-segmented, brown, three preapical segments pale. Pronotum very slightly transverse, with scarcely diverging, straight lateral

margins, with a distinct, fine impressed line along center, hind margin truncate. Meso- and metanotum distinctly and uniformly densely punctured, with a weak line along center. Rudiments of tegmina absent. Legs yellow, basal half of fore femora and two thirds of remaining femora brownish black, the base of all tibiae slightly darkened; fore femora stout, short, 1st segment of hind tarsus just longer than all the other segments taken together. Abdomen uniformly punctured above, like meso- and metanotum, but, with a small smooth area on the sides of each tergite, slightly dilated before apex, sides of 3rd-4th tergites with no trace of tubercles, sides of subsequent tergites normal. Last tergite more sparsely punctured, distinctly transverse; hind margin between convex ribs of forceps quite straight, slightly oblique on sides. Last sternite transverse, converging slightly caudad, indistinctly rugosely punctured in basal part, hind margin with deep, roundly arcuate excision. Forceps stout, slightly apart, almost symmetrical but, the left half just shorter and a little more curved at apex; underside flat; without a longitudinal impression. Genitalia with long, narrowly lanceolate metaparameres gradually tapering toward apex, virga absent. Body length 13, forceps 2.5 mm.

A very distinctive species, easily recognized by the absence of lateral tubercles on 3rd-4th abdominal tergites, the simple lateral parts of remaining tergites, the deeply excised apical sternite, the leg coloration and structure of the genitalia. This cannot be either A. quadrata Liu [1946] or A. setshuana B.-Bienko, also described from Szechwan.

The collection contained 1 ♀ from a similar locality (Omei Shan, 1150-2100 m, 26[VI]1955, collected by Yang Hsi-chih) and outwardly similar to the male described above. Yet it differed in having a very weakly punctured body and a very square pronotum. There was no justification for assigning this female to the species described.

The genus Anisolabis Fieb. is divided into almost 20 separate genera from the male genitalia alone. Yet, as before [Bei-Bienko, 1936], we consider them only as subgenera and insist on the desirability of the principle that genera should not be separated on the basis of the male genitalia alone, and, where necessary, such taxons should be granted only subgeneric rank.

Anisolabis (Paralabis) montshadskii, sp. n. (Fig. 16)

Yunnan: Puerh, 1350 m, 12[V]1957, 1 ♂ (D. Panfilov); Szemao, 1300 m, 26[III]1957, 2 ♂♂, including type and 1 ♀ (A. Monchadskii); Hsiaomongyang, 810 m, 31[III]1957, 1 ♂ (Liu Ta-Hua); Fohai, 1250 m, 28[II]1957, 1 ♂ (P'u Fu-ti); Tamonglung, 700 m, 10[IV]1957, 1 ♂ (D. Panfilov).

Small, brownish black or black, shining, rather slender. Head with very fine, weak sutures. Antennae 17(?) - segmented, brown, paling toward apex, 1st segment brownish yellow or yellow, darker inside, 2nd and part of 3rd segment yellow. Pronotum as broad as long, lateral margins very slightly divergent, with very narrow rufous edging. Wing organs absent. Legs rufous yellow femora with basal two thirds brown in otherwise completely black individuals, 3rd segment of hind tarsus noticeably shorter than 1st. Abdomen of ♂ with distinct, dense, fine deeply impressed puncturation; in ♀ puncturation less sharp, but still distinct; tubercles on 3rd-4th tergites weak, lateral parts of 7th-9th tergites of ♂ more coarsely and rugosely punctured, but, without longitudinal keel, their hind angles right. Last tergite of ♂ with a pair of weak tubercles behind middle, lateral margins with a rugosely punctured longitudinal stripe. Apical sternite of ♂ converging to apex, rugosely punctured, with an indistinct, large, round impression and distally with the rudiments of one or three longitudinal stripes, hind margin arcuate; in ♀ transverse with narrowly rounded obtuse-angled apex. Forceps in ♂ almost or fully contiguous at base, not obviously asymmetrical, the right half curving inward a little earlier; underside punctured, without longitudinal impression. Forceps in ♀ simple, inner side straight to apex, with a tooth there. Genitalia of ♂ with almost oval parameres tapering from base to apex, length of parameres twice their breadth, apex narrowly rounded, virga absent. Body length ♂ 11.5-12, ♀ 11, forceps ♂ 2.2-2.5, ♀ 2.2 mm.

The subgenus Paralabis Burr was known previously only from India, Ceylon and Africa. The species described is outwardly similar to A. (Euboriella) annulipes Luc., but, in fact is most closely related to A. (P.) pervicina Burr. from Assam [Burr, 1913, 1915], but differs in the leg coloration, distinctly punctured abdomen and details of the structure of the genitalia.

The species was named after Prof. A. S. Monchadskii.

Anisolabis (Gelotolabis) cavaleriei Bor.

Y.: Kunming and environs, 1[III]1957, 2 ♀♀, 21[III]1955, 2 ♂♂, 7 ♀♀, 5[IV]- 16[V]1956, 3 ♂♂, 1 ♀, 1 larva, Chingtung, 27[IV]1955, 1 ♀; Wuliang Shan near Chingtung, 21[III]1957, 1 ♂, 4 ♀♀; hills east of Tengchung, 10[V]1955, 1 ♂, 1 ♀.

In our monograph of the Dermaptera of the USSR and neighboring countries [Bei-Bienko, 1936] this species was assigned to the subgenus Mongolabis Zach. However, it is advisible to assign to that subgenus those species in which the male abdomen is expanded at the apex, like the genus Gonolabis Burr. The species in question has a normal abdomen, and in shape of parameres is very similar to A. (Gelotolabis) maxima Brullé; hence, we assign this and the following Chinese species with similar parameres to the subgenus Gelotolabis Zach., although the type of the subgenus, like its African relatives, does not have such angulate parameres.

A. cavaleriei Bor. is easily distinguished by the rufous yellow, unicolorous legs, the pale base of the antennae, the truncate hind margin of the apical sternite and the rugose lateral margins, lacking a longitudinal keel, of the preapical tergites of the male abdomen, and the absence of a longitudinal impression on the underside of the male forceps.

This species is obviously widely distributed in China, but, so far has been recorded only from the provinces of Shantung and Yunnan.

Anisolabis (Geolotolabis) undata, sp. n. (Fig. 17)

Yunnan: Chingtung, 1200 m, 27[IV]1955, 1 ♂ (Yang Hsi-Chih); Wuliang Shan, 2300 m, 22[III]1957, 2 ♂♂, (D. Panfilov); Ts'ang Shan near Tali, 2100 m, 30[IV]1955, 1 ♂ type and 1 ♀ (O. Kryzhanovskii); Mekong valley east of Paoshan, 1200 m, 5[V]1955, 1 ♀ (O. Kryzhanovskii); Tawei Shan, 1350 m, 23[IV]1956, 1 ♀ (D. Panfilov); mouth of R. Nanch'i-Ho, 200-300 m, 5-10[VI]1956, 2 ♀♀ (D. Panfilov).

Very close and externally similar to A. cavaleriei Bor. and also characterized by the unicolorous rufous yellow legs, the structure of the last tergite of the male abdomen (with a weak tubercle-like process dorsally on sides before hind margin and with a distinct longitudinal lateral keel), the structure of the forceps in ♂, also lacking a longitudinal impression along inner margin of underside, and the similar male genitalia. It differs in the following characters. Base of antenna not paler than rest, or if paler, then third segment not bicolorous, or only paler at very base. Abdominal dorsum finely, but more distinctly punctured, lateral parts of 7th-8th tergites of ♂ distinctly and unevenly longitudinally rugose, with a tendency to form a longitudinal, irregular keel. Apical sternite of abdomen of ♂ broad, transverse , with distinct, broadly arcuate excision on hind margin, hind-lateral angles very obtuse, widely rounded. Genitalia of ♂ also lacking virga, parameres almost 1.5 times as long as broad, oblique apical margin only a little longer than outer margin, both slightly but distinctly concave. so that outer angle of paramere is just isolated, rounded obtuse. Body length ♂,♀ 14-17, forceps ♂ 2.8-3.3, ♀ 3.5-4 mm.

It is interesting to note that in all the mountain individuals the antennae are unicolorous and dark, while in individuals from heights 200-300 m (R. Nanch'i-Ho) they have a series of pale preapical segments.

The record of A. marginalis Dohrn. [Broelli, 1927] from Yunnan probably refers to this species, or to the close A. panfilovi, sp. n. In any case, A. marginalis Dohrn is absent from the extensive series of Dermaptera from Yunnan.

Anisolabis (Gelotolabis) cheni, sp. n. (Fig. 18)

Yunnan: Wunch'uang, near Kunming, 15[V]1956, 1 ♂ (D. Panfilov); Hsia-kuan, 2050 m, 18[V]1957, 1 ♂ type and 1 ♀ (A. Monchadskii); Paoshan -Yungping road, 28[V]1955, 1 ♂ (V. Popov).

Small, brownish black or black, shining. Head with sparse scattered punctures sutures very fine but distinct. Antennae 17-18 segmented, brown, 2nd segment yellowish, one of the preapical segments sometimes pale. Pronotum very slightly transverse, lateral margins slightly divergent, without a paler rim. Wing organs completely absent. Legs rufous yellow, in ♀ basal two thirds of femora partially brownish; 3rd segment of hind tarsus noticeably shorter than 1st. Dorsum of abdomen in ♂ with very distinct, dense and fine, deeply impressed puncturation, in ♀ this puncturation is less sharp, but, clearly discernible; 3rd and 4th tergites with weak tubercles, sides of

6th-9th tergites of ♂ more coarsely and slightly rugosely punctured, their hind angles right, not rounded, a rudimentary longitudinal keel discernible on 7-8th tergites. Last tergite strongly transverse; in ♂ without tubercles on dorsum, lateral margins rugosely punctured. Apical sternite of ♂ strongly transverse, lateral margins passing roundly into hind margin; the latter with a broad, distinct but not deep, arcuate excision, underside coarsely punctured, but without impression; in ♀ transversely obtuse-angled, with rather broadly rounded apex. Forceps of ♂ a little apart at base, slightly asymmetrical, inner margin straight only in basal half; underside coarsely punctured, with no trace of an impression along inner margin. Forceps in ♀ simple, more slender than in A. (P.) montshadskii, sp. n., tapering rather strongly to apex, at apex gradually and weakly curving inward . Genitalia of ♂ lacking virga, parameres rather short, obtuse-angled outside, approximately 1.5 times longer than broad, all margins almost straight, apical angle acute, not produced. Body length ♂ 12.5-13.5, ♀ 12.5, forceps ♂,♀ 2.8 mm.

In form of paremeres and other characters of this species belong to the A. cavaleriei Bor. group, but in the coloration of legs and antennae, in form of apical sternite of male abdomen and absence of longitudinal impression on underside of male forceps, it most resembles A. undulata, sp. n. It differs from the latter in its smaller size, absence of tubercles on last tergite of male and the somewhat different shape of the parameres.

The species was named after Prof. Cheng Shih-hsiang, who has contributed a great deal to the study of the insect fauna of China.

Anisolabis (Gelotolabis) panfilovi, sp. n. (Figs. 19, 20)

Yunnan: Nangno Shan near Fohai, 1100-1500 m, 27[IV]1957, 1 ♂, 1 ♀ (Hung Kuang-ti); Kanglangpa on the R. Mekong, 450 m, 18[IV]1957, 1♀ (D. Panfilov); Chinping, 900-1700 m, 25-27[V]1956, 2 ♂♂, including type (D. Panfilov); 30 km southeast of Chinping, 400 m, 29[IV]1956, 3 ♂♂ (Huang K'o-jen).

Very similar to A. cavaleriei Bor. but differing in the following characters. Antenne brown or rufous brown, unicolorous, their base not distinguished by paler coloration, Pronotum of ♂ with quite parallel lateral margins. All femora blackish brown with a pale apex, tibiae also darkened to some extent or only hind tibiae pale. Abdomen also with small tubercles on 3rd-4th tergites and very finely punctured dorsally, but lateral margins, of 7th to 8th tergites at least, with a longitudinal keel. Apical sternite of ♂ with a large, but very weak, quadrangulate impression in center, hind margin broadly, transversely truncate or slightly concave. Pygidum of ♂ strongly convex below and behind and having the form of a cleft tubercle. Forceps of ♂ close together at base and broad there (the right blade a little less strongly curved in basal half than left), with a weak but very distinct impression along inner margin on underside. Genitalia of ♂ very similar to A. cavaleriei Bor., but parameres a little longer, apical oblique margin relatively longer, virga also absent, penis proper with very dense and more distinct minute denticles. Body length ♂♀ 18-21, forceps in ♂ 3.8-4.2, ♀ 4-4.8 mm.

In leg coloration and in possessing a longitudinal impression on underside of male forceps this species is similar to A. (Apolabis) marginalis Dohrn, but the latter is distinguished by the different construction of the parameres, [Borelli, 1927, Fig. 11; Bei-Bienko, 1936, Fig. 21].

The species is named after D. V. Panfilov, an active member of the expeditions of Yunnan.

Anisolabis (Gelotolabis) omei, sp. n. (Fig. 21, 24)

Szechwan: Omei Shan, 1600 m, 24[VI]1955, 2 ♂♂, including type (T. Bushchik).

♂. Similar to A. cavaleriei but differing in the following characters. Antennae yellowish brown, unicolorous to base, 4th-6th segments, or at least the basal two of them, spherical. Legs pale, rufous yellow. Dorsum of abdomen finely but distinctly punctured, sides of 7th-9th tergites not coarsely rugose, but with distinct and rather regular, longitudinal rugosity, 8th tergite with a trace of a longtidudial keel; last tergite without tubercle-like processes on sides of dorsum, but with a distinct lateral longitudinal keel. Apical sternite also distinctly converging toward hind margin, but the latter slightly concave. Pygidium projects downward and backward in the form of a cleft rounded tubercle. Forceps broader in basal two thirds and there with quite straight, proximate inner margins; their underside with a weak impression along inner margin. Genitalia also lacking virga, outer margin of paramere slightly concave, and so outer angle projects slightly like a tooth, apical oblique margin less than 1.5 times as long as outer margin and quite straight. Body length 19, forceps 4.3 mm.

The collection contains a single female with a similar date (Omei, Shan, 600-1100 m, 21[VI]1955, 1♀), externally resembling the male but the basal segments of the antennae are scarcely paler than the remainder, while the femora are blackish brown with a pale apex. Whether this female belongs to the species described is doubtful in view of the fact that the coloration of the legs and the base of the antennae is a stable character in the most closely related species.

Anisolabis (Gelotolabis) fallax, sp. n. (Fig. 25)

Yunnan: Tawei Shan near Pingpien, 1350 m, 22[VI]1956, 1 ♂ (D. Panfilov).

♂. Externally similar to A. panfilovi sp. n. Antennae, including base, black but the pair of preapical segments white. Pronotum very slightly expanding caudad, as broad as long. Legs with brownish black femora, tibiae scarcely paler, tarsi rufous. Dorsum of abdomen very indistinctly punctured, practically smooth, sides of 3rd and 4th tergites with weak tubercles, sides of 8th-9th tergites coarsely rugosely punctured, obtuse-angled, behind, slightly rounded; 8th tergite with trace of longitudinal keel. Last tergite with a weak, slightly transversely rugose tubercle-like process in front of hind margin on sides of dorsum, a coarsely rugose stripe broadening caudad on the sides and forming on the underside a slightly convex ridge. Apical sternite strongly converging caudad and narrowly truncate, as a whole having the form of an equilateral triangle with truncated apex; its underside without impression, transversely rugose in apical part. Forceps moderately asymmetrical, moderately separate at base, straight in basal two thirds and gradually constricting, then bending inward, the apex of the right blade turned inward perpendicular to its long axis; their underside with a weak impression along inner margin. Genitalia with slightly elongate parameres, their outer and oblique apical margins slightly concave, so that outer angle of paramere is just isolated, a little less than 90°, the apex of the paramere with a barely discernible excision (strong magnification!), virga absent. Body length 17.5, forceps 5 mm.

It differs from the outwardly similar A. panfilovi sp. n. in the uniform coloration of the femora, the different abdominal sculpture, the greater caudad convergence of the apical sternite lacking a quadrangulate impression, and details of the paramere. In the structure of the latter it is similar to A. omei sp. n., from which it differs in the coloration of the legs and antennae, the sculpture of the abdomen, and the structure of the apical sternite.

This species concludes our discussion of a series of six similar and closely related species grouped around A. cavaleriei Bor. Some of them have overlapping ranges, some are allopatric species; as a whole they can all be considered as duplicate species.

It is of interest to note that the differences between them consists mainly of different combinations of four to five characters: coloration of antennea and legs, structure of sides of abdomen, its apcial sternite, the forceps and, in some cases, the parameres. Evidently, this is an example of distinctive species polymerization and is probably an indication of one of the initial stages of breakup of a species and the current process of species formation. At the same time, they are all good species, quite distinguishable morphologically.

Anisolabis (Gelotolabis) magna, sp. n. (Fig. 22, 26)

Yunnan: Chinping, 1800 m, 21[V]1956, 1 ♂ type and 1 ♀ (D. Panfilov).

Large, almost uniformly black, shining. Head with very fine sutures. Antennae 23 to 24-segmented, uniformly brownish black. Pronotum very slightly diverging caudad, in ♂ slightly longer than broad, in ♀ practically square. Legs black with rufous brown tarsi, apex of tibiae with short rufous hairs. Abdomen very finely, in ♂ more distinctly, punctured, 3rd and 4th segmenst with indistinct tubercles; sides of 6th tergite, and 7th-9th particularly of ♂, distinctly punctured and longitudinally rugose, but their hind margins right-angled, only slightly produced on 8th-9th tergires. Last tergite in both sexes with lateral coarsely rugose stripes expanding caudad, dosrum with distinctly impressed longitudinal line and with a series of rugosely punctured longitudinal lines; with a rounded tubercular elevation on dorsal sides in front of hind margin in ♂. Apical sternite of ♂ transverse, at base finely, more distally coarsely, punctured, hind margin barely noticeably concave, almost straight, roundly passing into oblique, slightly concave lateral margins; a considerable portion of central surface of sternite impressed. In ♀ this sternite is smooth, transversely triangular, with roundly right-angled apex. Pygidium from below and from behind in the form of a cleft tubercle, Forceps long, in ♂ moderately asymmetrical, with a distinct impression along inner margin on underside, straight in basal half, then curving inward , gradually

at first and then strongly; in ♀ straight, in apical fourth slightly and gradually curving inward., flat along inner margin of underside, but without impression. Genitalia of ♂ with roughly trapeziform parameres broadening from base to apex, the outer part strongly produced in the form of a moderately acute angle, the inner margin slightly sigmoid, the apex produced into a short, rounded lobe; virga absent. Body length ♂ 28.5, ♀ 24, forceps ♂♀ 8 mm.

Close to A. (G.) vitalisi Burr from north Vietnam [Burr, 1917], but differing in the unicolorous antennae with a larger number of segments (in the species named they have, according to the description, 19-20 segments and pale preapical rings), the different structure of the parameres (In A. vitalisi Burr, their inner margin straight, outer angle right with rounded sides) and, evidently, other characters.

In their body size and outwardly angulate parameres these two species are very similar to A. maxima Brullé from the Canary Is. In the shape of the parameres the Canary species is more remote from the territorially close African species of the subgenus Gelotolabis Zach. and is closer to the above-mentioned Chinese species of this subgenus. Obviously these species form in the subgenus Gelotolabis Zach. a special ancient section which now remains only in the eastern and western Palaearctic and which have not lost their association with a tropical climate. We already pointed out [Bei-Bienko, 1936] that such wide gaps in ranges constitute a characteristic feature of palaearctic Dermaptera. However, the example of this section of the subgenus Gelotolabis Zach. is interesting in that the association with a tropical climate is still retained.

Anisolabis (Gelotolabis ?) externa, sp. n. (Fig. 27)

Yunnan; Wuliang Shan near Chingtung, 1900 m, 21[III]1957, 4 ♂♂, including type, and 3 last-instar larvae (D. Panfilov).

Brownish black, small, rather stout. Head with isolated, weakly impressed punctures, with almost or completely obliterated sutures. Antennae 16-segmented, dark brown. Pronotum very slightly transverse, with scarcely diverging lateral margins, the marginal rim being indistinctly rufous brown. Rudiments of wing organs absent. Legs rufous yellow, femora brownish black in basal two thirds; 3rd segment of hind tarsi noticeably shorter than 1st. Dorsum of abdomen with very distinct, fine, but deeply impressed puncturation, 3rd and 4th tergites with weak tubercles, lateral margins of 6th-9th tergites more coarsely and partly rugosely punctured, their hind angles obtuse, longitudinal keel distinct on 6th-8th or just on 7th-8th tergites. Last tergite strongly transverse, slightly convergent caudad, without a distinct longitudinal keel on sides. Apical sternite transverse, moderately convergent to apex, and with a weakly concave, rather broad hind margin and broadly rounded lateral angles; underside without impressions, with coarse, irregular impressed punctures in distal part. Forceps moderately apart at bases not distinctly asymmetrical, much as in A. (P.) montshadskii, sp. n., but their underside coarsely and irregularly punctured, with a distinct impression along inner margin. Genitalia with irregularly quadrangulate parameres, their length being 1.5 times their breadth, apex with short broad process and a small rounded emargination close to it, outer side, of this emargination marked by a sharp tooth; virga absent. Body length 12.14, forceps 2.7 mm.

Larvae. Similar to adults. Head with very fine but distinct sutures. Antennae 14-to 15-segmented. Legs yellowish brown, femora a little darker. Abdomen very uniformly, densely, finely, but distinctly punctured. Body length 7.5-9, forceps 2.5 mm.

The assignment of this species to the subgenus Gelotolabis Zach. is provisional in view of the distinct difference in the structure of the apex of the parameres. In this character, this species differs markedly from all other known representatives of the genus Anisolabis Fieb.

Anisolabis (Euboriella) femoralis Dohrn.

Y.: Chingtung, 6[V]1957, 1 larvae (f. euptera), 26[V – 1[VII]1955, 5 ♂♂, 7 ♀♀ (F. euptera), to light, Tungchiafeng 2, 14[VI]1956, 2 ♂♂ (f. euptera), on soil; 30 km southwest of Chinping, 23-26[IV]1956, 4 ♂♂, 1 ♀ (f. euptera); mouth of R. Nanch'i-Ho, 5-10[VI]1956, 7 ♂♂, 7 ♀♀ (f. euptera).

An investigation of the structure of the genitalia in a wingless male from Tungchiafeng, showed that its parameres had a characteristic curved inner margin (distinctly convex before apex, roughly sigmoid as a whole) and were indistinguishable from the parameres of the long-winged form. That the wingless male form belongs to the species named, hitherto known only from the long-winged form, is also borne out by other characters: the very stout, fore femora, the emarginate apical sternite, etc.

Obviously, A. femoralis Dohrn is characterized by a marked dimorphism; the majority of individuals are represented by the normal long-winged form (f. euptera), but among them we occasionally find the completely wingless form (f. aptera), which could easily be taken for A. annulipes Luc. It should be noted that in the case of the latter the reverse relationshipis known: its normal form is f. aptera, and there is an extremely rare f. euptera, which has been fully described by Pantel [1917].

Such an unusual and remarkable dimorphism becomes understandable if we consider the wingless individuals as a neotenic form of the species; the long-winged form in A. annulipes Luc., however, is a very rare atavistic form.

The variability of the species in question is manifested also in other characters: the body size, the degree of curving of the forceps, the structure of the lateral parts of the 7th-9th tergites of the male. For instance, in a few small individuals (southwest Chinping, 1 ♂; mouth of R. Nanch'i-Ho, 1 ♂) found at the same time as the normal forms, the lateral keels on the 7th-9th abdominal tergites of the male were not developed, which made these individuals like A. plebeja Dohrn. As regards the parameres, in one of them the outer obtuse angle was rounded, in other cases, it was more distinct.

Owing to this variablity, the differences between the long-winged forms of A. femoralis Dohrn. and A. plebeja Dohrn. tend to disappear; yet in the case of aptera these species are quite distinct from one another; in the former the f. aptera, as was shown above, is completely wingless, while in the latter it has lateral rudiments of tegmina [Hebard, 1927].

Known from Ceylon, India, Burma, Vietnam and recently recorded from Indonesia [Hincks, 1954]; first record for China.

The collection contains a series of wingless females from various localities in Yunnan: we could not assign these females to A. annulipes Luc.; it is possible that some of them belong to A. femoralis Dohrn.

Anisolabis (Euboriella) plebeja Dohrn.

Y.: Chingtung, 3[VI]1956, 1 ♂ (f. euptera).

This solitary male differs from the description of A. plebeja Dohrn [Borelli, 1926] and from the pair of females (det. M. Burr) from Sumatra in characters transitional to A. femoralis Dohrn.: darker coloration, larger body size and obtuse-angled hind margins of 6th-8th abdominal tergites. We have assigned it, however, to A. plebeja Dohrn. because the lateral margins of the abdominal tergites lack a longitudinal keel, the right blade of the forceps is weakly bent in the apical part, and the outer margin of the parameres is arcuate, with no trace of an obtuse angle.

Recorded already from China, but this is the first record for Yunnan.

Anisolabis (Euboriella) pallipes Shir.

Y.: Mangshih, 16[V]1955, 1 ♂.

A very small specimen (body length 7.8, forceps 1.3 mm). A species known from Japan, Taiwan and southeast China; first record for Yunnan.

Anisolabis (Euboriella) annulipes Luc.

Y.: Kunming and environs, 5[IV]1956, 2 ♂♂, 15[V]1956, 2 ♂♂, 3 ♀♀, 1[VI]1957, 2 ♂♂, 4 ♀♀; Chingtung, 11-12[III], 2 ♂♂, 1 ♀, 1 larva, 27[IV]1955, 1 ♂, 6-7[V]1957, 1 ♀, 2 larvae; Hsia-kuan, 30[V]1955, 1 ♂; Hsia-kaun – Yungping 1[V]1955, 1 ♂; Nuchiangpa, 9[V]1955, 3 ♂♂; Lungling and environs, 11-13[V]1955, 1 ♂, 1 ♀; Mangshih, 16-17[V]1955, 1 ♂, 2 ♀♀; Chingku, 15[V]1957, 1 ♂; Mokiang, 27[III]1955, 1 ♀; Chianghsitsai, 29-31 [III]-2[IV]2955, 4 ♂♂, 5 ♀♀; Puerh, 29[IV]1955, 1 ♀; Szemao, 12[IV]1955, 1 ♀; Cheli, 8[IV]1955, 1 ♀; Mentsz, 2[VI]1956, 1 ♂; Chingping, 20-30 km southwest, 22[IV]1956, 1 ♀, 28[V]1956, 1 ♀.

Judging from the individuals collected, this is one of the most common and widely distributed species in Yunnan. It ascends into the hills to heights of 1900-2050 m (Kunming, Hsia-kuan); it is apparently a winter-spring species, disappearing at the beginning of summer.

Cerolabis, subgen. nov. generis Anisolabis Fieb.

Wingless. Fore femora stout, short, as in Euboriella, Burr. Abdomen of ♂ moderately expanded before apex. Parameres of ♂ short, scarcely longer than broad, slightly expanded toward apex, outer angle with a distinct sharp tooth, apex with a spiniform process directed inward. Penis with a prominent sclerotized inclusion.

Type of subgenus – Anisolabis (Cerolabis) hwangi, sp. n.

Differs markedly from the closely related Euboriella Burr., as also from all the other known subgenera, in the distinctive structure of the parameres.

Anisolabis (Cerolabis) hwangi, sp. n. (Fig. 28)

Yunnan: Chinping, 1500-1700 m, 11[V]1956, 1 ♂ (Huang K'o-jen).

♂. Small, black, shining. Head with sparse puncture, frontal suture distinct, coronal suture less distinct. Antennae dark brown, 1st and 2nd segments rufous yellow, 4th-5th segmens not spherical. Pronotum slightly transverse, lateral margin almost straight, rufous brown. Metanotum short, with weakly concave hind margin. Legs brownish rufous, but femora gradually darken from apex to base and are brownish black there; 2nd and 3rd segments of hind tarsus together equal to 1st segment. Dorsum of abdomen distinctly and rather coarsely punctured, lateral tubercles on 3rd-4th tergites, indistinct, but hind margins of 2nd-6th tergites with weak granularity; sides of 7th-9th tergites, only slightly more coarsely punctured, without distinct keel, hind angles moderately obtuse, not rounded. Last tergite twice as long as broad, without lateral tubercles, on dorsum, without a distinct longitudinal keel or puncturation on sides. Apical sternite slightly transverse, with very oblique hind-lateral margins, hind margin not broadly truncate, forming with hind-lateral margins an obtuse, slightly rounded, angle; underside flat, distal part rugosely punctured. Forceps short, slightly asymmetrical; a little apart at base, inner margin sigmoid, indistinctly finely sinuate, apical fourth of left blade and apical third of right curving obliquely inward ; underside with coarse punctures, without longitudinal impression. Body length 11, forceps 2 mm.

Externally this species is not in any way distinctive, but is easily distinguished from all the other species by the genitalia.

The species is named after Huang K'o-jen, a scientific officer in the Instiute of Entomology in Peking, who took a particularly active part in collecting the material on the Orhtoteroidea.

PLACOLABIS, GEN. NOV.

Like Anisolabis Fieb. Wingless. Abdomen above and below with very distinct recumbent hairs, in ♂ moderately expanded before apex, 3rd-4th tergites with weak lateral tubercles, hind margins of abdominal sternites with long backward-pointed bristles; preapical (i.e., 7th visible) sternite of ♂ with a broad arcuate exicsion behind and a long parallel-sided flat process. Genitalia of ♂ without virga, parameres twice as long as broad, greatest width behind center, outer margin rounded,obtuse-angled, apex sharp but not produced.

Type of genus – Placolabis mira, gen. et sp. n.

In shape of parameres, this genus is similar to African representatives of Gelotolabis Zach. but differs sharply from all known species of the genus Anisolabis Fieb. in the presence of a long flat process on the penultimate sternite of the male.

Placolabis mira, sp. n. (Fig. 23, 29)

Yunnan: Cheli, 580 m, 9[IV]1955, 1 ♂ type and 1 ♀ (Ou P'eng-jung); Kanglangpa, 540 m, 16[III]1957, 1 ♂, 1 ♀ (Tsang Ling-ch'ao); Tamonglung, 700 m, 12[IV]1957, 1 ♂, 1 ♀ (P'u Fu-ti).

Pitch-black, shining. Head with weak sutures. Antennae 17-to 81-segmented, brownish black, 1st, 2nd and base of 3rd segment brownish rufous, a few of the preapical segments pale; 4-5th segments short. Pronotum square, metanotum short, weakly concave behind, legs uniformly rufous yellow. Abdomen with small, dense punctures on dorsum, sides of 6th-8th tergites of ♂ with longitudinal keel, but almost devoid of coarse punctures and asperity; process of preapical sternite of male excised at apex. Apical sternite of ♂ broadly truncate behind,

hind-lateral oblique margins form an obtuse, but not rounded, angle with hind margin. Apical sternite of ♀ transversely triangular, with narrowly rounded apex. Forceps stout, short, in ♂ almost or completely contiguous and moderately asymmetrical, apical fourth of left blade and third of right curved obliquely inward; underside in ♂ moderately convex along center. Body length ♂, ♀ 11.5-13, forceps ♂ 2.3-2.5, ♀ 2.8-3.1 mm.

The inale from Kanglangpa differs in its smaller size (body length 10, forceps 2.2 mm), and the absence of a longitudinal keel on the sides of the 6th-8th abdominal tergites; obviously this is merely a small, degenerate form of the species.

Judged by the locality of capture, the species belongs to the tropical area of Yunnan.

Nala lividipes Duf.

Y.: Chingtung, 26[VI]1956, 1 ♂, on light, Juili, 6[VI]1956, 1 ♂, 3 ♀♀.

Widely distributed, a frequently imported species. Inside mainland China it has been recorded only from the region of the seaport Tsingtao [Borelli, 1915; Bei-Bienko, 1936].

Nala nepalensis Burr.

Y.: Chingtung and environs, 6-15[III]1957, 8 ♂♂, 14 ♀♀, 27[IV]1955, 6 ♂♂, 9 ♀♀, 17[V]1957, 1 ♂, 4 ♀♀; Tungchiafeng, 14[III]1957, 3 ♂♂, 3 ♀♀; Paoshan-Yungping road, 1700 m, 28[V]1955, 3 ♀♀; Salween valley west of Paoshan, 8[V]1955, 2 ♂♂, 2 ♀♀; Yuankiang, 23-24[III]1955, 1 ♂, 1 ♀; Hsiaomongyang, 6[V]1957, 2 ♂♂, 2 ♀♀; Cheli, 8[IV]1957, 1 ♀.

This species evidently differs from the preceding congener in its different annual cycle, in consequence of which it is absent from the 1956 collections, which were made at later periods than in 1955 and 1957 (from end of May to July).

Recorded from eastern Himalayas; there is no reliable record from China, although it was included by error in a list of Chinese species [Wu, 1935].

Labidura riparia Pall.

Labidura cryptera Liu, 1946; 20, pl. 2, Fig. 6 (larva; Peh-Chi and Pan-Chi in Chungtung, prov. Szechwan) (syn. nov.).

S.: Chengtu, 18[VI]1955, 1 ♀; Omei Shan, 20[VI]1955, 1 ♂, 1 ♀. Y.: Kunmnig, 25[III]1955, 5 ♀♀, and 2 larvae, 1[VI]1957, 1 ♂; Chingtung, 4-15[III]1957, 56 ♂♂, 62 ♀♀ and 14 larvae, 10-21[IV]1957, 27 ♂♂, 48 ♀♀, and 6 larvae, 27[IV]1955, 2 ♂♂, 2♀♀, 6-30[VI]1956, 1 ♂, 2 ♀♀; Salween valley west of Paoshan, 9[V]1955, 1 ♂, 1 ♀; Mangshih, 17[V]1955, 1 ♀ and 1 larva; Sanati Shan, 18[V]1955, 1 ♂; Kaolikung Shan near Tengchung, 2400 m, 10[V]1955, 1 ♂; Yuankiang, 24-25[III]1955, 2 ♂♂, 5 ♀♀ and 2 larvae; Szemao, 12[IV]1955, 1 ♀; Hsiaomongyang, 6[IV]1955, 1 ♂; Cheli, 7[IV]1955, 2 ♂♂; Kanglangpa, 13-16[III]1957, 10 ♂♂, 13 ♀♀ and 16 larvae; southeast of Chinping, 27[V]1956, to light, 1 ♀; mouth of R. Nanch'i-Ho, 10[VI]1956, on light, 2 ♂♂, 1 ♀.

Judged from the abundance of specimens collected, this is one of the commonest species. The majority consisted of the morph bidens, and can be characterized as DF $\frac{Zb}{We} \cdot \frac{3}{3}$ by means of the system of symbols [Hebard, 1923; Bei-Bienko, 1936].

The Labidura cryptera Liu (1946) described from near Chungking in Szechwan is, according to the description and figure, a last-instar larva of Labidura riparia Pall. and, hence, is included in the synonymy of this species.

Forcipula decolyi Borm.

Forcipula clavata Lui, 1946; 22 pl. 2, Fig. 8 (♂, ♀; Pan-Chi and Peh-Chi in Chungking, prov. Szechwan) (syn. nov.).

Forcipula clavata var. unica Liu, 1946: 23, pl. 2, Fig. 10 (♂; Pan-Chi and Peh-Chi in Chungking, Szechwan) (syn. nov.).

S. Omei Shan, 600-1100 m, 21[VI]1955, 2 ♀♀.

Y.: Chingtung and enrivons, 10-15[III]1957, 15 ♂♂, 13 ♀♀ and 5 larvae, 27[IV]1955, 1 ♂, 3 ♀♀ and 2 larvae, 1-17[V]1957, 1 ♂, 7 ♀♀ and 2 larvae; Paoshan-Yunging road, 28[V]1955, 1 ♂, 1♀ ; Szemao, 23[V]1957, 2 ♂♂, 6 ♀♀ and 1 larva; Hsiaomongyang, 4[IV]1957, 4 ♂♂, 1 ♀ and 1 larva, Chingping, 14[V]1956, 1 ♂.

Some of the specimens were caught on light. All the specimens had wing scales projecting to some extent and belonged to var. longipennis Bor., described fron north Vietnam. The females outwardly very similar to Labidura riparia Pall., but can easily be distinguished by the structure of the forceps; their inner margin is armed with a distinct blunt tooth in the preapical part.

The F. clavata Liu and var. unica Liu, described by Liu [1946] from the Chungtung district, are synonyms of the species of question. In fact, this author distinguished his species from F. decolyi by the presence of projecting wing-scales, the greater the number of antennal segments, the less curved distal part of the male forceps and the presence of an inner preapical tooth on the female forceps. Obviously this author based the separation of this species on a comparison with the figure and incomplete description of F. decolyi in the well-known monograph of Indian Dermaptera [Burr, 1910] and did not allow for the variablity of the first three characters, and, in particular, for the fact that in F. decolyi, a form with projecting wing-scales (var. longipennis Bor.) is known. As regards the reference to differences in the structure of the female forceps, it is based on ignorance of the true F. decolyi, – the female of this species possesses just such forceps as were described for F. clavata Liu.

Var. unica was described only from males, and it was a puzzle why females of this variety had not been found ("It is not yet understood why the female of the variety has never been found while the male is fairly frequent in the places surveyed", Liu,[1946, 23]. The reasons is simple. var. unica is a small male form, possessing forceps of simplified structure; in the female, however, the forceps are always simpler and less variable, and obviously all the females were assinged to the typical form by the author. It should be noted that a similar small form with simplified forceps structure has been described also for males of a related species – F. trispinosa Dohrn.[Burr, 1910; 93].

According to Liu's account, this species in Szechwan stays close to rivers and streams. In Yunnan, according to O. L. Cryzhanovskii and D. V. Panfilov, it also occurs along the banks of rivers, usually at the very edge.

Forcipula pugnax Kirby var.

Y.: Salween valley west of Paoshan, 100 m, 11[V]1955, 2 ♂♂, 4 ♀♀ and 3 larvae; near water.

Differs from typical F. pugnax Kirby from north India and Burma in having only three pairs of lateral abdominal projections in the male and the wing-scales hidden under the tegmina. That this is a definite subspecies is not out of the question, but its separation would be premature without a study of more abundant material from different parts of its range.

Platylabia major Dohrn.

Y.: 15 km north of Chingtung, 31[V]1956, 2 ♂♂, under bark of trees; Tungchiafeng, 24[VI]1956, 2 ♂♂ under bark; Lunling, 20[V]1955, 1♀ ; Szemao Chlei road, 3[V]1957, 1 ♂ and 1 larva; Shikuyav, 27[IV]1957, 1 ♂, 1 ♀; Nango Shan, 27[IV]1957, 1 ♂.

The single male from Tungchiafengand the female from Lungling were represented by the fully winged form (f. euptera); these individuals had longer tegmina, considerably longer than the pronotum, wing-scales fully developed, in male equal in lengthof pronotum in female shorter than it. All the remaining individuals, had shorter tegmina, approximately equal in length to prontoum, while their wing-scales were short, lateral; to this form we can apply the logical desgination – f. mesoptera.

Known from Burma, Vietnam, the Philippines, Indonesia, Malaya and Hainan in China [Hincks, 1940]; first recorded for mainland China.

Apachyus feae Borm.

Y.: Chingtung, 20[III]1957, 1 larva, 27 [IV]1955, 1 ♂, 12[V]1957, 1 larva; Wuliang Shan, 21-30[III]1957, 3 larvae; 15 km north of Chenyaun, 26[IV]1955, 1 ♂, 2 ♀♀, 1 larva, hills west of Yungping, 2000 m, 5[V]1955, 1 ♂, 4 ♀♀; Lungling, 12[V]1955, 2 ♂♂, 2 ♀♀; Santai Shan, 18[V]1955, 1 ♀; Szemao, 29[III]- 3[IV]1957, 12 larvae; Hsiaomongyang, 4[IV]1957, 2 ♂♂, 2 ♀♀, 1 larva, 3[V]1957, 1 ♂, 1 ♀; Cheli and distinct, 31[III]- 9[IV]1957, 1 ♀, 3 larvae, 26[IV]1957, 1 ♂, 2 ♀♀; Nango Shan, 27[IV]1957, 4 ♂♂, 4 ♀♀; P'uweng, 27[III]1957, 3 larvae.

Known from eastern Himalayas, Assam, Burman and Vietnam; hence, the discovery of this species in Yunnan is not unexpected, although it enriches the fauna of China by a very distinctive representative of the order.

Found only under bark.

LABIIDAE

Apovostox pygidiatus Dubr.

Y.: Lungline, 19[V]1955, 1 ♂; Hsiaonmongyang28[III]1957, 1 ♂.

A widely distributed Indo-Malayan, species, known also from Burman, but not recorded from Chian prior to this.

Apovostox semiflavus Borm.

Y.: 30 km southeast ofChinping, 370 m, 4[V]1957, 2♀♀ .

Known from Burman, Vietnam, India, Indonesia, the Philippines and Taiwan; first record for mainland China.

Apovostox pilosus, sp. n. (Fig 30)

Yunnan: Chinping, hills 1800 m, 21[V]1956, 3 ♂♂, including type, and 1 ♀ (D. Panfilov).

Large (for genus), rather squat, brown to blackish brown, with dense long hairs, moderately flattened. Head dark brown or black, frons moderately convex, sutures obliterated; eyes large, equal in length to genae and almost equal, or in ♀, equal to 1st antennal segment. Antennae 15-segmented, brown or almost black, 3rd segment long, almost cylindrical, 4th subconical, a little shorter than 3rd, 5th also subconical, subequal to 3rd, subsequent segments at first cylindroconical, then almost spindle-shaped. Pronotum as broad as long, or in ♂ f. brachylabia slightly transverse, lateral margins parallel, hind margin broadly rounded; prozona pyriform convex; a pair of convex longitudinal ridges along center in front of flat metazona. Tegmina and wings with rather long, weakly recumbent hairs, brown or blackish brown. Legs yellowish brown, in the darker ♂ the femora are partly brownish black; 1st segment of hind tarsi a little longer than 3rd, on outer ventral side long bristles with a series of irregularly disposed short spinules between them, with a ribbon-like fringe of fine, closely recumbent short hairs of equal lengths, on inner side. Abdomen with long and short, dense rufous hairs. Last tergite strongly transverse, almost three times as broad as long, in hind aspect with a weak central impression on each side of which, over the base of the forceps there is a weak swelling. Apical sternite also strongly transverse, in ♂ with broadly rounded hind margin, barely noticeably concave in center; in ♀ hind margin more strongly and regularly rounded, with no trace of median excision. Pygidium large, in basal half stout, almost cylindrical, slanting strongly ventrad, lamellate distally. In ♂ f. macrolabia the lamellate part of the pygidiym broadens toward center where it has a tooth on each side, then constricts distally and on apex there is a shallow, but broad obtuse-angled excision separating two rounded lobes; in ♂ f. barchylabia the lamellate part broadening to hind margin, lateral margins undulate, but without median tooth, hind margin without incision in center, very slightly convex, hind-lateral angles with a strong tooth. Pygidium of ♀ with black, slightly serrate lateral margins in basal part; lamellate apical part with almost straight, subparallel lateral margins, hind margin in dorsal aspect transversely truncate. Forceps in ♂ f. macrolabia almost straight, long, gradually approaching from base to apex; inner margin in basal half very slightly concave, almost flat, with no teeth, centrally with one tooth above, apical half slightly serrate on underside. Forceps in ♂ f. brachylabia diverging in basal half, then roundly incurved, inner margin with two teeth in apical half, one of them central. Forceps in ♀ straight, long, gradually approaching from base to apex, base near pygidium with black inner margin and tiny denticle; inner ventral margin sharp

almost to middle, serrulate more distally, but serrulations evanescent in apical quarter. Body length ♂ (excluding pygidium) 8.5-9, ♀ 7, forceps ♂ f. macrolabia 4.4-4.6, f. brachylabia 2.7, ♀ 3.4 mm.

Differs markedly from type of genus Apovostox Heb. (A. pygidium, Dubr.) in external form, denser and longer hair covering, structure of pygidium and other features. It should be noted, however, that the generic subdivisions of the subfamily Labiinae s. lat. are often based on variable and obscure characters and require a thorough revision.

Labia lutea Borm.

Y.: Chenyuan, 15 km to north, 1800 m, 26[IV]1955, 1 ♀; 40 km southeast of Chingku, 1000 m, 13[V]1957, 1 ♂; Szemao, 11[IV]1955, 1 ♂; Szemao-Cheli road, 850 m, 3[V]1957, 1 ♂; Cheli, 27[IV]1957, 1♀ ; Nango Shan near Fohai, 1100-1500 m, 2[III, 27[IV]1957, 2 ♀♀; Kanglangpa, 15-16[III]1957, 2 ♂♂, 2♀♀ ; 30 km southwest of Chinping, 370 m, 4[V]1956, 1 ♂, 3 ♀♀.

Known from northeast India, north Vietnam, Indonesia and Hainan in south China [Hincks, 1947]; not hitherto recorded from mainland China.

Labia mucronata Stal ?

Y.: Cheli, 9[III]1957, 1 ♀.

A species widely distributed in southeast Asia, known from Burma. The determination from a single female may not be accurate and requres confirmation.

Labia curvicauda Motsch.

Y.: Chingtung and environs, 29[V-24[VI]1956, 5 ♂♂, 3 ♀♀, under bark; 13[III]1957, 1 ♂; Salween valley west of Paoshan, 9[V]1955, 1♀ ; Chianghsitasi, 29[III]1957, 1 ♀; Szemao, 11-13[IV]1955, 3 ♂♂, 29[III]1957, 1 ♂; Hsiaomongyang, 28[III]1957, 1 ♂; Cheli, 9[III]1957, 1 ♂; Kanglangpa, 16[III]1957, 1 ♂; mouth of R. Nanch'i-Ho, 5[VI]1956, 1 ♂.

A widely distributed tropical species, which has been transported, into all parts of the world, and known also from Japan, Taiwan and Kuantung province in southeast mainland China [Borelli, 1927]; not hitherto recorded from Yunnan.

Marava nigrella Dubr.

Y.: 30 km southwest of Chinping, 22[V]1956, 1 ♂.

A widely distributed Indo-Malayan species, colored in dark and light shades and recalling an ant. Not hitherto recorded from China.

Chaetospania feae Borm.

Y.: Fohai, 1300 m, 28[II]1957, 1 ♂; Nangno-Shan near Fohai, 1400 m, 2[III]1957, 1 ♀; Tawei Shan near Pingpien, 1350-1600 m, 23-24[VI]1956, 1 ♂, 2 ♀♀; hills near Chinping, 2000 m, 10[V]1956, 1 ♂.

Described from Burma and widely distributed in southwest Asia. First record from China.

Chaetospania fallax Borm.

Y.: Hsiaomongyang, 4[V]1957, 1 ♂; Szemao-Cheli road, 850 m, 3[V]1957, 2 ♀♀; Cheli 22[IV]1957, 9 ♂♂, 10 ♀♀; Cheli-Tamonglung road, 640 m, 29[IV]1957, 5 ♂♂, 9 ♀♀; Kanglangpa, 141-5[III]1957, 3 ♂♂, 1♀ ; Mang-shih, 580 m, 22[IV]1957, 3 ♂♂, 2 ♀♀; 20 km southeast of Chinping, 400 m, 23[V]1956, 1 ♂.

The apex of the pygidium in the male in always triangular, with a distinct median denticle and usually very weak lateral denticles. In some males, the forceps tend to form a median lamellate rib on inner margin, thus, representing transition to the structure typical of the females.

A widely distributed Indo-Malayan species, first record from China.

Chaetospania silvestrii Bor.

Y.: Hsiaomongyang, 28[III]1957, 1 ♀; Cheli-Tamonglung road, 640 m, 29[IV]1957, 1 ♀; Kanglangpa, 14-15[III]1957, 20 ♂♂, 12 ♀♀; Mengtsz, 22[IV]1957, 1 ♀; Tawei Shan near Pingpien, 22-27[VI]1956, 1 ♂, 3 ♀♀; 30 km southwest of Chinping, 28[IV]1956, 1 ♂, 1 ♀.

Described from a single male from north Vietnam [Borelli, 1927]; it is distinguished by the long pygidium, deeply cleft at the apex into two sharp lobes. The male from Tawei Shan differs from typical specimens in having a very broad pygidium, flat distally, the excision deep but rectangular, the lateral margins convex, each with a pair of denticles; the females from this same locality were indistinguishable from typical Ch. silvestrii. This is probably only a deviation, and not a separate species, but for a definite conclusion additional material will be required.

The undescribed female is characterized by the following features.

♀ (nova). Forceps at base broad, with distinct tooth in hind aspect. Pygidium half-vertical, tapering from base to middle, then parallel-sided, apex with transverse, very slightly concave hind margin. As a whole, it is very similar in form of pygidium and forcpes of Ch. dichroma Heb. from Sumatra [Hebard, 1927, pl. 3, Fig. 1]. Body length ♀ 5.3-7.5, forceps 1.6-2 mm.

Chelisoches morio F.

Y.: mouth of R. Nanch'i-Ho, 9[VI]1956, 11 ♂♂, 13 ♀♀, and 4 late-instar larvae.

All the adult specimens with short, slightly projecting wing-scales, tarsi dark brown.

A widely distributed tropical species. Included in the "Catalogus Insectorum Sinensium" [Wu, 1935], but without any definite information on its being found in China.

Proreus ritsamae Borm.

Y.: Kanglangpa, 17[IV]1957, 1 ♂.

Known from Burma and Indonesia; not hitherto recorded in China.

Proreus simulans Stal.

Y.: Cheli, 1 ♂, 1♀.

A widely distributed Indo-Malayan species, extending to Shanghai and Nanking [Hincks, 1937] inside mainland China, but not previously recorded from Yunnan.

Prereus weissi Burr. subsp. ?

Y.: Szemao-Cheli road, 850 m, 3[V]1957, 2 ♀♀; Hsiaomongyang, 3-5[V]1957, 3 ♂♂ (f. macrolabia), 2 ♀♀; Nango Shan, 1100-1200 m, 24[IV]1957, 1 ♀; Cheli, 22[IV]1957, 1 ♂; Mangshih, 22[IV]1957, 1 ♀.

Describedfrom north Vietnam from a single male [Burr, 1904]. Our series differed slightly from the descriptions in the pale head and pronotum, and the presence on the male forceps of only one inner tooth, situated in the distal part. The females were identical with one in the collections of the Zoological Institute AN SSSR, a female from north Vietnam (Montes Mauson, Tonkin, 1 ♀, H. Fruhstorfer, det. M. Burr), apart from the pale head and very slightly shorter pygidium.

If the differences in the head coloration are stable, the individuals from Yunnan must be separated into a local subspecies. As regards the differences in the male forceps, we must bear in mind that the type P. weissi undoubtedly belongs to f. brachylabia (forceps length 3.7 mm), while our specimens belong to f. macrolabia; hence, it is possible that these differences have no taxonomic significance and are merely manifestations of dimorphism in the males. The body size of our specimens were: ♂ 9-12.5, forceps 4.5-5.2; ♀ 12-15, forceps 4.8-7.5 mm. The female is characterized by a protruding conical pygidium with truncate apex.

Proreus inermis, sp. n. (Fig. 31).

Yunnan: Tawei Shan near Pingpien, 1360 m, 24[VI]1956, 1 ♂ type (D. Panfilov); 20 km southwest of Chinping, 400 m, Chinping, 400 m, 28[V]1956, 1 ♀ (D. Panfilov).

Slender, rufous brown with black and yellow markings. Head black, broader and less convergent behind than in P. simulans Stal, a strong transverse arcuate impression in front of hind margin, sutures indistinct. Antennae yellow with a series of (or solitary) black segments, 4th segment shorter or almost equal to 3rd and 5th separately, almost cylindrical, subsequent segments very slender, cylindrical. Pronotum almost 1.5 times as long as broad, with parallel lateral margins, bicolorous; prozona brownish black, metazona and lateral margins brownish rufous. Tegmina and wing-scales black or brownish black. Legs uniform yellow. Abdomen with fine but very distinct puncturation, rufous brown, with black sides in basal half. Last tergite with solitary (evanescent in male) granules on weak swellings in front of hind margin, in the interspace a depression with a pair of tiny adpressed tubercles, developed only in ♂; lateral margins in ♀ with distinct, but not granular, sigmoid keel, terminating at lateral angles in a tiny sharp denticle. Apical sternite of ♂ evenly punctured, with a weak impression along center, hind margin very slightly convex in center; in ♀ more weakly punctured with weak rugosity along center, hind margin almost truncate at center. Pygidium of ♂ vertical, trapeziform, slightly transverse, converging ventrad, transversely truncate at apex and with a small denticle at the angles; in ♀ larger, in distal part constricting suddenly to apex, more convex, lateral margins slightly granular and black above, apex transversely truncate. Forceps long, slender, weakly bent, with no sign of large denticles inside, in ♂ with a blackish, sharp margin in basal half, in ♀ weakly serrate. Body length ♂ 11, ♀ 13, forceps ♂ 4.1, ♀ 4.2 mm.

Similar to P. weissi Burr, but differing in the bicolorous pronotum, the unarmed forceps, the absence in the male of distinct denticles on the sides of the two preapical sternites, details of the sculpture of the hind part of last tergite of male and its different pygidium. Also resembles P. fuscipennis Haan, but differs in the black head and absence of teeth on forceps.

Hamaxas feae Borm.

Y.: Szemao-Cheli road, 850 m, 3[V]1957, 1 ♀; Hsiaomongyang, 5[V]1957, 1 ♂.

Known from Burma, north Vietnam [Borelli, 1927] and Indonesia; not hitherto recorded from China.

Hamaxas kozlovi Sem. et. B.-Bienko

Y.: Tawei Shan, 25[VI]1956, 1 ♂.

Similar in all respects to type apart from the darker coloration and weakly developed denticles at base of inner margin of forceps.

Obviously, a widely distributed species. Described from Inner Mongolia [Semenov et Bei-Bienko, 1934], and later recorded from Chekiang in eastern China and with a question mark (only females) from northeast Burma [Hincks, 1947]. The finding of this species in Yunnan verifies and supports the record for Burma and considerably extends the known range southward.

Solenosoma birmanum Borm.

Y.: Szemao, 23[V]1957, 1 ♂, 1♀; Cheli-Tamonglung road, 29[IV]1957, 1 ♀; P'uweng, 4[IV]1957, 1 ♂.

Known from Burma and Assam, first recorded for China.

The females were unknown hitherto. Externally and morphologcially they differ markedly from the males, and are more like species of the genus Proreus Burr; yet, the finding of both sexes in Szemao at the same time and in the same locality by the same collector (A. S. Monchadskii), as well as the absence of wing-scales and other general morphological characters, compels us to assign these females to this species.

♀ (nova). Body of normal outline, moderately flattened, brown, brownish rufous anterad. Head normal, not elongated. Pronotum with parallel lateral margins, only slightly elongate, hind margin moderately rounded. Tegmina almost contiguous with hind margin of pronotum, scutellum half-hidden apex obliquely truncate. Last tergite of abdomen with 6 very tiny tubercles forming a transverse series in front of center of hind margin,

lateral margins with short asperate keel in front of hind-lateral angles. Pygidium semivertical from behind, converging ventrad, with an obtuse-angled excision at apex. Forceps stout, short, flat underneath, of equal width in basal half, with indistinct denticles inside near middle, flattened in apical half, gradually tapering and bent toward tip. Body length 10, forceps 2.7 mm.

In accordance with the above information the diagnosis of the genus Solenosoma Burr must be modified and, in particular, supplemented to include a type of sexual dimorphism unusual for earwigs – affecting the body form, structure of head and pronotum.

Adiatethus glaucopterus Borm. (Fig. 32-33)

Y.: Chingtung, 5, 26[VI]1956, 2 ♂♂, 6[III]1957, 1 ♀; Tungchiafeng, 25-30[V]1956, 2 ♂♂, 1 ♀; hills 30 km north of Chingtung, 1400 m, 25[V]1956, 1 ♀ under bark of tree; Juili, 11[VI]1956, 1 ♂; Hsiaomongynag, 3-4[V]1956, 1 ♂, 4 ♀♀; Szemao-Cheli road, 3[V]1957, 1 ♂; Cheli, 27[IV]1957, 1 ♂; Szemao-P'uweng road, 11[V]1957, 1 ♀; P'uweng, 4[IV]1957, 1 ♀; Kanglangpa, 17[IV]1957, 2 ♀♀; Tamonglung, 10[IV]1957; 4 ♂♂, 9 ♀♀; Tawei Shan, 19[VI]1956, 1 ♀.

A very distinctive species with metallic-hued body, known hitherto from Burma and Assam and recorded in China for first time.

Male forceps variable – in f. barchylabia with inner tooth at base, in f. macrolabia with tooth near middle; yet, in one male (from Tamonglung), although the forceps were long, they had a series of small denticles inside at the center and beyond it, and a strong conical tooth turned inward and obliqeuly upward. The pygidium in females was also of variable structure; in typical individuals it was pointed at the apex, but, a few females had a pygidium with a blunt apex (Fig. 33).

FORFICULIDAE

Forficula schlagintweiti Burr

Y.: Kaolikung Shan, 10[V]1955, 2 ♂♂, 2 ♀♀.

A Himalayan montane species extending northward to southern Tibet and westward to Kashmir; recorded also from northeast Burma [Hincks, 1947].

Forficula ledongae Heb.

Y.: Lungling, 15[V]1955, 1 ♂; Lungling-Mangshih, road, 1200 m, 19[V]1955, 1 ♂, 1 ♀; Kaolikung Shan, 10[V]1955, 1 ♂.

Described from Sikkim [Hebard, 1923] and later recorded from the mountainous northeast of Burma [Hincks, 1947]; the discovery of this species in western Yunnan extends its range to the limits of southeast China.

The male from Kaolikung Shan has projecting, though short, wing-scales, i.e., it belongs to f. euptera, from which this species was described; in the rest of the specimens the wings are not developed.

The collection contains another male from Kaolikung Shan, which was found along with F. legongae and F. schlagintweiti and which combines the characters of both these specimens. It is smaller than the latter and has a brownish red head; the puncturation of the abdomen is distinct, but, shallower than in F. legongae; the forceps are broadened at the base to equal $\frac{1}{3}$ of their length. Is this a hybrid form of the species named?

Forficula biplaga, sp. n. (Fig. 34)

Szemao: Omei Shan, 580-1150 m, 26[VI]1956, 1 ♂ (Ou P'eng-jung).

♂. Black. Frontal suture on head obliterated, but a discernible impression in its place, coronal suture weak. Antennae with black 1st segment (the rest broken off). Pronotum definitely transverse, with broadly rounded hind margin. Tegmina brownish black, with a weak, diffuse, yellowish-brown spot in center. Wing-scales with brownish black inner margin, the remainder yellow, clearly differentiated. Tarsi yellowish brown, 1st segment of fore and middle tarsi not longer on upperside than 2nd segment and lobe together (hind legs broken off). Abdomen pitch-black, the dorsal central part dark rufous brown, the base smooth dorsally, but, with punctured

sculpture becoming gradually stronger with distinct and rather large, dense punctures, these tergites stronger toward apex, 6th-9th tegrites, and the 5th with a convex, transverse granular stripe on sides in front of hind margin. Last tergite, smooth, only in places with longitudinal stripes of small punctures, with transverse-oval swellings and an intermediate depression over base of forceps, a weak pit in front of this depression. Apical sternite with roundly obtuse-angled hind margin, distinctly punctured. Pygidium vertical from behind, tapering ventrad, in ventral aspect long, ridge-like with blunt apex. Forceps broad almost to middle, contiguous and serrate along inner margin, then constricted and weakly bent, enclosing on oval space. Body length 11.5, forceps 3.4 mm.

Rather like F. acris Burr, but, differing distinctly in the structure of the abdomnal tergites and the pale, prominent wing-scales. In the presence of asperate ribs on the sides of the abdominal tergites it resembles Hypurgus humeralis Kirby.

Forficula acris Burr

Y.: Kunming and environs, 18[III]1955, 1 ♂, 14[V]- 18[VII]1956, 2 ♂♂, 8 ♀♀, 4[VI]1957, 4[VI]1957, 1 ♀; Chingtung and environs, 10-18[III]1957, 2 ♀♀, 27[IV]1955, 1 ♂, 1 ♀ and 31[V]1956, 1 ♀ under bark; Wuliang Shan, 22[III]1957, 1 ♂, 8 ♀♀; Hsia-kuan, 30[V]1955, 14 ♂♂, 9 ♀♀; Funi to east of Hsia-kuan, 2000 m, 1[VI]1955, 4 ♂♂, 1 ♀; Paoshan-Yungping road, 5, 28[V]1955, 1 ♂, 4 ♀♀; Tali, 15[IV]1957, 1 ♀, 31[V]1955, 9 ♂♂, 11 ♀♀; Salween valley west of Paoshan, 11-21[V]1955, 3 ♀♀; Mekong valley east of Paoshan 1200 m, 28[V]1955, 1♀ ; Lungling-Paoshan road, 21[V]1955; 2 ♀♀; Lungling and environs, 1200-1600 m, 12-20[V]1955, 3 ♂♂, 2 ♀♀; Mangshih, 19[V]1955, 1 ♂, 3♀♀ ; Kaolikung Shan, 10[V]1955, 1 ♂, 1 ♀; Mokiang 27[III]1955, 1 ♀; Cheli-Szemao road, 3[IV]1957, 2 ♂♂; Nangno Shan, 24[IV]1957, 2 ♂♂, 1♀ ; Tawei Shan, 1350 m, 23[VI]1956, 2 ♂♂, 3 ♀♀; Chinping and environs, 1200-1800 m, 10-16[V]1956, 25 ♂♂, 23♀♀ ; Mengtsz, 2[VI]1956, 1♂; mouth of R. Nanch'i-Ho, 5-10[VI]1956, 2♀♀.

Known from India, Assam, Sikkim and northeast Burma; first record for China. Judged from the series given, this is one of the commonest species in Yunnan; but, it is apparently confined here to the mountainous regions, and is seldom found in the lowlands of the south and southeast of the province.

Very variable in size of body, coloration, shape of pronotum and structure of cerci. Specimens from southeast Yunnan (Tawei Shan, Chinping, Mengtsz, Nanch'i-Ho) have the smallest body size.

Forficula splendida B.-Bienko

S.: Chengtu, 29[V]1955, 2 ♂♂, 3 ♀♀.

Described from the south of Kansu province, but, this is first record for Szechwan.

In its aggregate of characters, this species is very close to F. acris Burr and, hence, in its relationships, tends toward the Indian, and not the palaearctic fauna. It differs from that species in the nontransverse, or very slightly transverse pronotum and the very fine, dense puncturation of the male abdomen.

Forficula davidi Burr

S.: Omei Shan, 13[VI]1955, 1 ♂. Y.: Kunming-Chuhsiung road, 19[V]1956, 3 ♀♀; Hsia-kuan, 30[V]1955, 1 ♂, 2 ♀♀; hills west of Yungping, 2000 m, 5[V]1955, 3 ♂♂, 2♀♀ ; Tali, 15[IV]1957, 2 ♀♀

An endemic Chinese mountain species, extending northward to Kansu province and northeast Tibet [Bei-Bienko, 1936]; first record for Yunnan.

Forficula davidi externa, subsp. n

Yunnan: Chingtung, 1200 m, 10[III]1957, and 13[VI]1956, 2 ♂♂, including type (N. Borkhsenius, O. Kryzhanovskii); Wuliang Shan near Chingtung, 1850 m, 22[III]1957, 1 ♂ (D. Panfilov); Paoshan, 1600 m, 13[V]1955, 1 ♂ (V. Popov); Lungling, 1600 m, 14[V]1955, 2 ♂♂ (Yang Hsi-chih); Mokiang, 1300 m, 27[III]1955, 1 ♂ (T. Bushchik); hills near Chinping, 1700 m, 16[V]1956, 1 ♂ (Huang K'o-jen).

♂. Differs from typical form in the smaller size and more slender body. Pronotum only slightly or moderately transverse. Wing-scales may have an indistinct pale patch. Forceps more slender, their broadened base frequently paler than remainder. Body length 9.5-13.5, forceps 3.8-8 mm.

One male from Chingtung belongs to f. macrolabia and has very long forceps, slightly undulate in profile, the papilliform tubercles on the last abdominal tergite in this male are distinctly conical and long. Individuals from Paoshan and Lungling have darker tegmina, lack pale patches on the wing-scales and possess weaker papilliform tubercles on the last tergite; as a whole these individuals appear transitional to F. acris, and only the much more obtuse hind inner angle of the expanded part of the forceps leads us to assign them to F. davida externa subsp. n. It is quite possible that females of this subspecies are indistinguishable from F. acris, and hence, we have not succeeded in separating them from the larger series of F. acris recorded above.

Evidently, F. davidi in the extreme southeast of its range not only forms a local subspecies but becomes variable, is reduced in size, and shows a tendency to lose some of the species characters and to reduce the gap between it and one of the related species.

Morphologically, particularly in the structure of the forceps, F. davidi externa, subsp. n. is very similar to F. hinnulea Hincks from northeast Burma [Hincks, 1947]. They are both clearly similar to the Ussurian-Manchurian F. vicaria Sem. (but, lack the isolated inner denticle), while the latter is undoubtedly related to the west palaearctic F. auricularia L.

Forficula ornata Borm.

Y.: Chingtung, 10[III]1957, 1 ♂ and 27[VI]1956, 1♀; Salween valley west of Paoshan, 8[V]1955, 1 ♀; Juili, 8[VI]1956, 1 ♂; Lungling, 15[V]1955, 1 ♀; Chingku, 27[IV]1955, 1 ♂; Szemao, 17[II]1957, 1 ♀; Cheli, 29[III]1957, 1 ♂; Cheli-Mongchia road, 620 m, 22[IV]1957, 1♀; Tawei Shan, 1350 m, 25[VI]1956, 1 ♀; 30 km southwest of Chinping, 16[IV]1956, 1 ♀.

Known from India, Indonesia, north Vietnam and Burma; first record for China. In some individuals (from Szemao and Chinping) the pale patch on the tegmina is small, rounded.

In its aggregate of characters this species is very like F. sagitta Sem. from Central Asia and Transcaucasia, and which was recently recorded from northeast Burma [Hincks, 1947], but, it differs in the broadly rounded hind margin of the pronotum, the shorter 4th antennal segment and the more gradual tapering of the expanded part of the male forceps into the unexpanded part.

Forficula sinica B.-Bienko

Forficula serrata Liu 1946; 17, pl. 1, Fig. 7 (♂, Mt. Omei, Szechwan) (syn. nov.). S.: Omei Shan, 4-26 [VI]1955, 3 ♂♂. Y.: Chinping, V[1956], 1 ♂.

Described from Mungu-Tshiuti in Szechwan [Bei-Bienko, 1934] and is easily distinguished by the slightly clavate 3rd antennal segment, the structure of the forceps, and the presence of the outside of their base of a tiny tubercle (sometimes, concealed by the edge of the last abdominal tergite).

An examination of the species type (in the collections of the Zoological Institute AN SSSR), the above-recorded males from Omei Shan (topotypes of F. serrata Liu) and the description of the last tergite has convinced me that F. serrata is a pure synonym of F. sinica. None of the differences between them, mentioned in the Liu's work [Liu, 1946] (structure of antennae, pronotum, pygidium and forceps), can be considered as valid.

In its aggregate of characters it is very close to the tropical Asiatic F. ambigua Burr.

Guanchia bicarinata Hincks

S.: Omei Shan, to a height of 2100 m and more, 18, 25[VI]1955, 1 ♂, 1 ♀. Y.: Wunchuang near Kunming, 15[V]1956, 1♀; Yungping-Paoshan road, 1250 m, 5[V]1955, 3♀♀.

Described from northeast Burma [Hincks, 1947], first record from China. Its discovery on Omei Shan in Szechwan is particularly interesting.

Anechura (Odontopsalis) modesta, sp. n. (Fig. 35)

Yunnan: Tali, 2200 m, 15[IV]1957, 1 ♂ type and 1 ♀ (A. Monchadskii).

Pitch-black, rather slender. Antennae yellowish brown, 12-segmented, 3rd segment not longer or very slightly longer than 4th, each of them appreciably shorter than 5th. Pronotum moderately transverse, with yellowish brown lateral margins. Tegmina fully developed, slightly rugose. Wing-scales more than half length of pronotum, almost smooth. Legs yellowish rufous. Dorsum of abdomen with distinct, rather dense, impressed punctures, in ♂ with subparallel sides. Last tergite with less uniform puncturation, in ♂ transversely quadrangulate, with weak swellings and an intermediate depression in front of hind margin over base of forceps, the entire hind margin quite transverse, barely noticeably concave in center, lateral angles right, not rounded. Pygidium of ♂ quadrangulate in dorsal aspect, moderately transverse, hind margin with a pair of small tubercles; in ♀ prominent, appearing triangular from above, elongate-quadrangulate from below. Forceps short, rufous brown; in ♂ straight in profile, at inside of base a dorsal, stout, short conical tooth touching hind angle of pygidium, behind the tooth a weak expansion on underside, slightly sinuate on margin, more distally the forceps gradually taper to apex and are slightly incurved there. Body length ♂ 13.5, ♀ 15, forceps ♂ 3, ♀ 2.7 mm.

In forceps and pygidium of male it resembles A. (O.) potanini B.-Bienko from east Sikiang [Bei-Bienko, 1934, 1936], but differs in details of the structure of these parts, and the fully developed wing organs.

Anechura (in sp.) primaria, sp. n. (Fig. 36)

Szechwan: Omei Shan, 580-760 m. 21[VI]1955, 1 ♂ (Ko Ts'ung-ling).

♂. Black with brown markings. Head black, sutures obliterated. Antennae brown, 3rd segment shorter than 4th, the last just a little shorter than 5th. Pronotum slightly transverse, with broadly rounded hind margin, brownish black with pale lateral margins. Tegmina and wing-scales yellowish brown, with sparse impressed punctures. Legs dark brown, tarsi slightly paler. Abdomen black, dense, with small, impressed punctures. Last tergite transverse-quadrangulate, barely discernibly expanding caudad, smooth in basal part, hind margin thickened over a base of forceps and slightly oblique, straight in central part and with a distinct impression between thickened lateral parts, lateral angles prominent, right. Apical sternite with roundly obtuse-angled hind margin.Pygidium large, vertical, subcordate, in dorsal aspect weakly projection, strongly transverse, in hind aspect with a convexity on upperside and flat ventral and lateral parts, lateral margins slightly converging ventrad, lower margin truncate. Forceps in basal fourth diverging and gradually constricting, thence, directed straight back, in dorsal aspect almost straight to incurved apex, in lateral aspect gradually curving downward and from center gradually curving upward teeth and other armament absent. Body length 11, forceps 5.2 mm.

In the undulate toothless forceps and external form, it is similar to Anechura (Borelliola) euxina Sem. from the Caucasus, but, differs in the fully developed wing organs. Morphologically it probably corresponds to some measure to the original, primitive type of subgenus Anechura Scudd.

Anechura (in sp.) torquata Burr

S.: Omei Shan, 580-1100 m, 18-27[VI]1955, 3 ♂♂, 2 ♀♀ Y.: Lungling 19[V]1955, 1 ♂.

Described from north Vietnam, and hence, the finding of this species in Yunnan is quite understandable. It is more interesting, and even rather unexpected, to find it in Szechwan.

It should be noted that this species is very similar, if not identical, with A. pulla Shir. from Taiwan, which was erroneously referred to as A. crinitata Shir. in Burr's work [Burr, 1910, Tab. 7, Fig. 10, Tab. 8, Fig. 4], as Shiraki [1928] pointed out; evidently Borelli [1927] made the same mistake.

Allodahlia scabriuscula Serv.

Y.: Tungchiafeng, 13-14[III]1957, 3 ♂♂, 7 ♀♀; Szemao, 26[III]1957, 1 ♂; Hsiaomongyang, 3-5[V]1957, 2 ♂♂, 3 ♀♀, Mongchia, 22[IV]1957, 1 ♂; Shikuyao, 7[IV]1957, 1 ♂; Nangno Shan, 1[III]1957, 2 ♂♂, 1 ♀; P'uweng, 2[IV]1957, 1 ♀; Kanglangpa, 18[III]1957, 1 ♀; Tawei Shan, 15-27[VI]1956, 19 ♂♂, 11 ♀♀, some on light, and 6 larvae; Chinping, 21[V]1956, 2 ♂♂; 30 km southwest of Chinping, 2[V]1956, 1 ♀.

Widely distributed in southeast Asia; their northermost localities known are Szechwan and the Tsingtao area of Shantung [Bei-Bienko, 1936].

Allodahlia bispina, sp. n. (Fig. 37)

Yunnan: Wuliang Shan, 1800-2400 m, 21[III]1957, 1 ♀ (Hung Kuang-ti); near Pingpien, 700 m, 29[VI]1956, 1 ♂ type (D. Panfilov).

Brownish black, shining. Head with distinctively impressed sutures. Antennae 12-segmented, dark one preapical segment pale. Pronotum almost semicircular, transverse, fore margin straight, prozona convex, almost smooth, remainder with dense, but not coalescing, impressed punctures. Tegmina with rugose structure, as in A. macropyga Westw., but broader with arcuately projecting outer margin, their bases with a rufous brown tinge. Wing-scales smooth, inner margin indistinctly rufous brown. Legs black, tarsi with rufous hairs, 2nd segment weakly dilated. Dorsum of abdomen finely and densely punctured, sides of 4th-6th tergites of ♂ with coarse, asperate puncturation. Last tergite smooth at base, remainder punctured, with a weak transverse swelling over base of forceps, hind margin between forceps straight; lateral angles in ♂ scarcely projecting. Pygidium of ♂ short, semivertical, with a strong, short conical tooth on sides in hind aspect; in ♀ also transverse, but, lateral teeth very weak with a swelling between them. Forceps of ♂, as in A. scabriuscula Serv., weakly undulate in profile, at base with a blunt tooth dorsally, with tiny denticles on inner margin in basal half, and with one small tooth beyond middle. Forceps in ♀ long, slender, cylindrical. Body length ♂♀ 14, forceps ♂♀ 9 mm.

Combines characters of different species; in the form of pronotum, board tegmina, structure of pygidium and male forceps it is very similar to A. scabriuscala Serv., but, in scupIture and in the shining coloration of the body, it is reminiscent of A. macropyga Westw. It differs from both these species in its aggregate of character.

Allodahlia macropyga Westw.

Y.: hills west of Yungping, 2000 m, 5[V]1955, 1 ♂; Paoshan-Yungping road, 28[V]1955, 1 ♂; Mangshih, 17[V]1955, 1 ♂; Tawei Shan, 22[VI]1956, 1♀ ; hills near Chinping, 1500-2000 m, 10-21[V]1956, 8 ♀♀.

Known from the Himalayas mountainous regions of Burma and southern Tibet [Burr, 1910]; the discovery of the species of Yunnan extends its known range toward the northeast.

Allodahlia coriacea ooraicea Borm.

Y.: Hsiaomongyang, 5[V]1957, 1 ♀; Tatukang, 4[V]1957, 1 ♂; P'uweng, 2[IV]1957, 1 ♂, 1♀ ; Cheli-Tamonglung road, 22[IV]1957, 1 ♂, 2 ♀; mouth of R. Nanch'i-Ho, 7-10[VI]1956, 1 ♂, 1♀ .

Known from Burma to Indonesia, but, not previously recorded from China.

Allodahlia coriacea signata, subsp. n.

Yunnan: Chingtung, 1200 m, 6[III]1957, 1 ♀ (D. Panfilov); Lungling, 26[VI]1956, 1♀ (Chou Peng-shou); Puerh, 1400 m, 21[IV]1955, 1 ♀ (O. Kryzhanovskii); Szemao, 1200 m, 26[III]1957, 1 ♂ (A. Monchadskii); Hsiaomongyang, 800 m, 19[III]1957, 1 ♂, 2 ♀♀, 6[IV]1955, 2 ♂♂ (Wang Shu-yung, Hsueh Yu-feng); Cheli, 500-580 m, 9[III]1957, 1 ♂ type and 3 ♀♀, 8[IV]1955, 1 ♂, 8-14[VI]1957, 1 ♂, 2 ♀♀ (Liu Ta-hua, V.Popov, P'u Fu-ti); Mongchia, 620 m, 22[IV]1957, 1 ♂ (Wang Shu-yung); P'uweng, 950 m, 8[V]1957, 1 ♂ (Liu Ta-hua); Cheli-Tamonglung road, 600 m, 22[IV]1957, 1 ♀ (Liu Ta-hua); Kanglangpa, 540 m, 13-19[IV]1957, 4 ♂♂, 5 ♀♀ (Wang Shu-yung, Liu Ta-hua , D. Panfilov, P'u Fu-ti). Tamonglung, 700 m, 9-11[IV]1957, 2 ♂♂, 6♀♀ (Liu Ta-hua, D. Panfilov, Hung Kuang-ti); 20-30 km southwest of Chinping, 370-500 m, 17[IV]- 4[V]1956, 6 ♂♂, 12 ♀♀ (Huang K'o-jen, D. Panfilov).

In all respects like typical form, except that the wing-scales stand out sharply against the general dark background of the body due to their pale yellow to brownish yellow coloration; all the femora are uniformly dark. Size as in typical form.

The difference in coloration of this subspecies is so marked that at first sight, it gives the impression of a different species. It should be mentioned that in some localities (Hsiaomongyang, P'uweng, Cheli-Tamonglung road) this subspecies is found together with typical A. coriacea Borm., but, this does not prevent its separation as a subspecies since in the main part of its range (Burma, northern India, etc.) only the typical form occurs.

Hypurgus humeralis Kirby

Y.: Chingtung, 24[V]- 30[VI]1956, 7 ♂♂, 8 ♀♀ on light; Chinku, 23[IV]1955, 1 ♂; Hsiaomongyang, 7[V]1957, 1 ♂; 30 km southwest of Chinping, 400 m, 16[IV]- 1[V]1956, 2 ♂♂, 1 ♀; mouth of R. Nanch'i-Ho, 5[VI]1956, 1 ♀ on light.

Some of the specimens belong to var. vittatus Burr. [1911]. The males are inhomogeneous in structure of forceps and sculpture of sides of abdomen; the majority of them are typical, but 3 males have weaker asperity on the sides of the abdomen and lack the preapical denticle inside the forceps, thus, making those males similar to the females.

Known from Ceylon and India to Burma; not previously recorded from China.

Kosmetor maculata, sp. n.

Yunnan: Kanglangpa, 540 m, 16-18[III]1957, 1 ♂ type and 1 ♀ (P'u Fu-ti, Hung Kuang-ti).

Small, brown with pale markings. Head reddish yellow, sutures indistinct. Antennae 12-segmented, yellowish, darker at apex; segments rather long, 1st not longer (♂) or scarcely longer (♀) than longest middle segments, 3rd almost cylindrical, 4th thicker but not shorter than 3rd, both much shorter than 5th; pronotum as broad as long, lateral margins parallel in front half, then gradually passing into broadly rounded hind margin. Tegmina with yellow elongate patch in fore part. Wing-scales longer than pronotum, with large yellow patch on outside and yellow band at apex on inner margin. Legs yellow, tarsi short, 2nd segment strongly expanded, 1st segment of hind tarsus equal to 3rd. Abdomen yellowish or reddish brown dorsally, with distinct, moderately dense, impressed punctures, tubercles and parts adjacent to them black. Last tergite also with impressed punctures, slightly converging caudad, in ♂ slightly impressed in center and on sides, lateral margin slightly carinate; hand margin straight in center, oblique at sides, sinuate in ♀. Pygidium of ♂ short, broad, convex dorsally in hind aspect, moderately constricted ventrax. Forceps of ♂ set wide apart yellow at base, then dark, rather long, almost straight in basal two thirds, slightly incurved distally, dorsally with a strong, sharp, inturned tooth on inner margin before middle. Forceps in ♀ simple, also with a yellow base. Body length ♂ 6.8, forceps ♂ 2.8, ♀ 2.3 mm.

In the character of the male forceps it resembles K. vishnu Burr from Sikkim, but, differs in the spotted tegmina and wings and the different proportions of the antennae segments. Externally the male is very reminiscent of Anechura (Odontopsalis) japonica Borm., but is much smaller.

Kosmetor eurypaga, sp. n. (Fig. 38)

Yunnan: Kunming, 1900 m, 14[V]1956, 2 ♂♂, including type (D. Panfilov).

♂. Slender, long, black with admixture of lighter color. Head black, frontal suture, except central part obliterated; coronal suture very fine. Antennae 13-segmented, black, becoming slightly brown toward apex; antennae slender, 3rd segment very slightly longer than 4th and shorter than 5th. Pronotum slightly transverse, black with pale lateral margins and a narrower and less distinct brownish rim along hind margin. Tegmina and wing-scales blackish brown, with isolated impressed punctures. Legs brownish rufous, 1st segment of hind tarsus almost twice as long as 2nd and a little longer than 3rd. Abdomen black, very finely and indistinctly punctured dorsally. Last tergite transversely quadrangulate, with weak rounded swellings over base of inside of forceps and an impression between these swellings, lateral angles almost right, not rounded and not projecting. Apical sternite with roundly obtuse-angled hind margin. Pygidium very broad, strongly projecting, wedge-shaped, broadened caudad, hind margin thickened, slightly concave, rugose, with a small tubercle in center, hind angles terminating in a denticle underneath; underside of pygidium also strongly broadened toward apex, with straight or slightly concave lateral margins. Forceps rufous brown, long, slender, almost straight, very weakly incurved in apical third, in lateral aspect straight, beyond middle very gradually and weakly curving upward; inner margin almost flat, before end of basal third, with a sharp tooth pointing inward. Body length 13.5-15, forceps 7.5 mm.

Differs from all the known species in the very broad pygidium and resembles representatives of the subgenus Odontopsolis Burr of the genus Anechura Scudd.

Eudohrnia metallica Dohrn.

Sondax pubescens Liu, 1946; 15, pl. 1, Fig. 1 (larva: Mount Omei, prov. Szechwan) (syn. nov.).

S.: Omei Shan, 3-24[VI]1955, 35 ♂♂, 46 ♀♀ and 30 larave. Y.: Paoshan-Yungping road, 28 [V]1955, 1 ♂, 1 ♀; Mekong valley east of Paoshan, 28[V]1955, 3 ♀♀; Mangshih, 16[V]1955, 4 ♀♀; Santai Shan, 18[V]1955, 1 ♂; Chinping, 11[V]1956, 2 ♂♂; 30 km southwest of Chinping, 22[V]9156, 1 ♂, 1 ♀.

A widely distributed Indo-Malayan species; this is the first record from China and is is evidently confined here to the tropical and subtropical parts of the country. Active by day, especially, during rain and after it, it occurs on plants (O. L. Kryzhanovskii).

The Sondax pubescens Liu [1946] described from Mt. Omei is merely a last-instar larva of Eudohrnia metallica Dohrn. This was easily verified by a comparison of the above-recorded series of larvae, topotypes of S. pubescnes Liu, with its description and illustration. Hence, S. pubescens Liu becomes a synonym of Eudohrnia metallica Dohrn.

A widely distributed Indo-Malayan species, recorded hitherto from China only for the Tsintao area [Borelli, 1915; Bei-Bienko, 1936].

Timomenus oannes Burr

Y.: Chuhsiung near Kunming, 18[V]1956, 1 ♂; Hsiaomongyang, 28[III]1957, 1 ♂; Pingpien, 1926[VI]1956, 1 ♀; Tawei Shan near Pingpien, 27[VI]1956, 1 ♀.

Described from Assam, and then later recorded from north Vietnam [Burr, 1910] and Yunnan in China [Borelli, 1927]. In its aggregate of characters, it is close to T. komarovi Sem.

Timomenus komarovi Sem.

S.: Omei Shan, 17[VI]1955, 1 ♂.

Known previously from the Ussurain territory, Korea, northwest China and Taiwan. The finding to this species in Szechwan considerably extends its range to the southwest.

The Timomenus zeae Liu [1946; 16, pl. 2, Fig. 2] described from Szechwan, including Omei Shan, has nothing in commom with T. komarovi Sem. and possibly belongs to the subgenus Odontopsalis Burr of the genus Anechura Scudd.

Timomenus lugens Burr

Y.: Chingtung, 17[VI]1955, 1 ♀, 20[V]- 2[VII]1956, 7 ♂♂, 24♀♀, some on light and on plants; Tungchia-feng, 19-29[V]1955, 2 ♀♀; Paoshan-Yung ping road, 28[V]1955, 8 ♂♂, 18♀♀; Mekong valley east of Paoshan, 1200 m, 28[V]1955, 2 ♂♂, 1 ♀; Nuchiangap in Salween valley, 9[V]1955, 1 ♂; Mangshih, 17[V]1955, 1 ♂, 22-26 [VI]1956, 1 ♂, 1 ♀; 25 km west of Chenkang, 1280 m, 15[V]1955, 1 ♂; Chiangsitsai, 50 km southwest of Mokiang, 30[III]1955, 1 ♀; Hsiaomangyang, 3[V]1957, 2 ♂♂; Szemao and Szemao-P'uweng, 26[III]- 23[V]1957, 3 ♂♂, 5 ♀♀; P'uweng, 8[V]1957, 3 ♂♂, 2 ♀♀; Kanglangpa, 540 m, 19[IV]1957,1 ♂; Tawei Shan near Pingpien 1500 m, 22[VI] 1956, 1 ♂; Chinping, 22-27[V]1956, 5 ♂♂, 3 ♀♀; 30 km southwest of Chinping, 370-420 m, 13-19[IV]1956, 2 ♀♀.

Known from Burma and Assam, but this is first record in China. According to the records cited, it is widely distributed and common in Yunnan. Active by day, especially in damp weather.

The tubercles on the sides of the 6th-9th abdominal segments of the male, a characteristic feature of this species, are variable and are not a valid species character; in some specimens they are particularly distinct, in other, they are weaker, and in some of the specimens from south Yunnan (2 ♂♂ from P'uweng, 1 ♂ from Szemao-P'uweng and 1 ♂ from Kanglangpa) they are not apparent at all.

In the structure of the male forceps this species is simliar to representatives of the genus Eparchus Burr.

Eparchus insignis Haan

Y.: Chingtung, 27-28[IV]1955, 2 ♀♀, 31[V]1956, 1 ♀, on light; Salween valley west of Paoshan, 9[V]1955, 1 ♀; Mekong valley east of Paoshan, 1200 m, 5[V]1955, 1 ♀; Mokiang, 27[III]1957, 1♀; Hsiaomongyang, 31[III] 1957, 1 ♂, on light; Cheli, 9[III]1957, 1♀; Nangno Shan, 1100 m, 27[IV]1957, 1 ♂, on light; Tamonglung, 700 m, 10[IV]1957, 1 ♂; Tawei Shan, 1350 m, 25[VI]1956, 1 ♂; hills near Chinping, 1200 m, 27[V]1956, 1♀; 30 km southwest of Chinping, 420 m, 19[IV]1956, 2♂♂; mouth of R. Nanch'i-Ho, 7[VI]1956, 1 ♀, to light.

Some of the individuals were of smaller size (♂ 8-9.5, ♀ 9 mm); in this case, the tubercles on the sides of the 6th-8th segments were either weaker than in the (normalor were reduced in number to two weak ones (on 7th-8th abdominal segments, rarely on 6th-7th) or were absent altogether (Tawei Shan, 1 ♂; southwest of Chinping, 1 ♂). A reduction of the abdomnial lateral tubercles has also been noted in small specimens from south India [Borelli, 1931]. It is obviously a characteristic feature of small individuals of this species, and this must be taken into consideration in identification; otherwise, serious errors may arise.

Eparchus panfilovi, sp. n.

Yunnan: Wuliang Shan near Chingtung, 1850 m, 22[III]1957, 1 ♂ (D. Panfilov).

♂. Very similar in forceps structure to E. inermis Heb. from Assam [Hebard, 1923]. Brownish black. Head rufous brown, as in E. insignis Haan, with two small pits between eyes and a transverse impression on frontal suture. Pronotum very slightly elongate, lateral margins slightly convex, brown, prozona slightly convex with impressed ling along center and a distinct impression on the sides. Tegmina dark rufous brown; wing-scales of same color, but, with yellow tips, shorter than pronotum. Legs brown, 3rd segment of hind tarsus equal to three quarters of length of 1st. Abdomen shagreened above as in E. insignis Haan, but a little more distinctly, lateral margins of tergites evenly asperate, 7th-9th tergites with distinct, slightly serrate, oblique keels, together forming an irregular ridge slanting steeply downward. Last tergite smooth, rugose and very weakly swollen over base of forceps, in form as in E. insignis Haan, but sides have an irregular, granular longitudinal keel in apical half. Forceps long and slender, proximate in basal third and armed inside with a distinct marginal keel which extends on to the upper-side caudad, thence gradually diverging, straight, not distinctly serrate inside, but beyond middle slightly arcuate, approaching distad and crossing, distinctly thickened at base or apical fourth, with a small denticle, but not distinctly denticulate. Body length 12, forceps 6.7 mm.

Easily distinguished from E. inermis Heb. by the specialized sides of 7th-10th abdominal tergites and details of the structure of the forceps, which also resembles the forceps of Narberia simplex Borm. as well as those of E. inermis Heb.

Narberia simplex Borm.

Y.: Hsia-kuan – Yungping road, 1800 m, 4[V]1955, 1 ♀; Szemao, 1-26[III]1957, 2 ♂♂, 2 ♀♀; Tawei Shan, 17-26[VI]1956, 8 ♀♀; hills near Chinping, 1700 m, 16[V]1956, 1 ♀.

A widely distributed Indo-Malayan species, also known from Burma, but not previously recorded from China.

COSMIOLA, GEN. N.

Similar to Cosmicula Hincks. Eyes less prominent, much longer than genae, frontal suture obliterated, a transverse impression in its place. Antennae more slender, wtih very long segments, 1st segment equal to distance between eyes on frons. Tegmina fully developed, twice as long as pronotum, their lateral margin with a distinct keel in basal two thirds, apcial third with no trace of keel. Wings fully developed, wing-scales long. Second segment of tarsi narrow, scarcely broader than rest and strongly produced under base of 3rd in the form of a long narrow lobe; 1st segment of hind tarsus 1.5 times as long as 3rd. Abdomen expanding from base to center, then contracting more strongly to apex. Last tergite slightly constricted and depressed caudad. Forceps in ♂ gradually tapering from base to apex, with no strong processes, or teeth, slightly diverging at first, then converging gradually from middle and crossing at apex.

Type of genus — Cosmiola simplex, sp. n.

The known Asiatic relatives of this genus, including Cosmiola Hincks, have somewhat abbreviated tegmina and lack wings. The simplified forceps structure, the fully developed wing organs and the narrow 2nd segment of the tarsi indicate the relative primitiveness of this genus and distinguish it clearly from other representatives of the group.

Cosmiola simplex, sp. n. (Fig. 39)

Yunnan: Chinping, 1800 m, 21[V]1956, 2 ♂♂ (D. Panfilov).

♂. Brownish black, weakly shining. Head brownish red, antennae brownish black, individual preapical segments partially whitish. Pronotum as broad as long, fore angles moderately obtuse but not rounded, sides with broad, reddish brown lamellate margins produced upward , slightly convex. Wing scales not shorter than pronotum, their inner margin rufous yellow in apical part. Legs brownish red. Dorsum of abdomen finely and weakly punctured, sides of 5th-7th tergites distinctly granular. Last tergite smooth, hind margin straight in center, a weak impression in front of it, lateral parts slightly oblique. Apical sternite with broadly rounded hind margin. Pygidium distinct, vertical, with a distinct rounded tubercle on underside in hind aspect. Forceps brownish red. Genitalia with rather broad parameres with convex outer margin, the apex roundly blunt, virga stout, almost straight apart from base, not reaching apex of penis lobe. Body length 12-12.5, forceps 4.6-4.8 mm.

Externally this species is rather reminiscent of Narberia simplex Borm., but is much more slender, and has a distinct keel on the lateral margin of the tegmina and a narrow 2nd tarsal segment.

Cosmiola cornuta, sp. n. (Fig. 40)

Yunnan: Wuliang Shan near Chingtung, 1900 m, 21[III]1957, 6 ♂♂, including type, and 5 ♀♀ (D. Panfilov); Chinping, 1800 m, 21[V]1956, 1 ♀ (D. Panfilov).

Brownish black to rufous brown, almost matt. Head brownish red, eyes as long as genae, sutures distinct, a distinct impression on frontal suture. Antennae 11-segmented, brownish black, individual preapical segments completely or partly whitish; 1st segment a little shorter than distance between eyes. Pronotum as broad as long, with rounded fore angles, lateral margins very slightly convex, slightly paler than disk. Tegmina moderately abbreviated, usually revealing at base the triangular scutellum, obliquely truncate at apex, their length along junction (anal margin) equal to pronotum; outer margin with distinct keel, evanescent in apical third. Legs brownish rufous, 2nd segment moderately expanded, 1st segment of hind tarsus almost 1.5 times as long as 3rd. Dorsum of abdomen finely and densely, but very distinctly rugosely punctured, sides of tergites in ♂ almost indistinguishable in sculpture from dorsum. Last tergite distinctly converging to apex, smooth in basal part, with weak rugose swellings and intermediate depression over base of forceps; lateral margins in ♂ at base with a process in the form of a little horn or tooth, or this process is very weak, tubercle-like. Forceps of ♂ long, blades contiguous at base, moderately flattened, slightly serrate inside and in distal part with a raised lamellate margin; thence distinctly diverging, but bending inward at an obtuse angle before middle, then straight, cylindrical, with a tubercle inside on preapical part, apex gradually pointed and slightly incurved, awl-shaped. Forceps of ♀ simple, long, slender, slightly incurved at apex, awl-shaped. Body length ♂ 10-12, ♀ 9.5-12, forceps ♂ 5.5-9, ♀ 5-5.8 mm.

Differs markedly from C. flavicornis Hincks from Burma in a number of significant characters, particularly the incomplete outer keel on the tegmina, the form of the male forceps and the presence of a lateral process on the last tergite.

General Review of the Dermapteran Fauna of Szechwan and Yunnan

Of the 86 species listed, 79 were found in Yunnan and 14 in Szechwan, and if we include records in the literature these figures must be raised to 80 and 30 species respectively (including in Szechwan the adjoining area of eastern Sikiang). In fact, for Yunnan the number of species must be increased to 90 by adding those which were determined only to genus (Diplatys — 3 species, Cranopygia — 1, Anisolabis — 1, Chaetospania — 1, Apovostox — 2, Marava — 1, Eparchus — 1).

The significance of these figures becomes more appreciable from the following comparisons: the fauna of the well-investigated vast territory of the USSR numbers only 26 species of Dermaptera [Bei-Bienko, 1936], i.e., less than Szechwan; the well-investigated fauna of Burma has up to 82 species; only 70 species were known from the whole territory of mainland China, and now their number exceeds 130.

This is clear evidence of a marked increase in the richness of the dermapteran fauna on transition from the temperate zone to the moist subtropics and tropics, and of its remarkable flourishing in Yunnan and Burma. It is also clear that we have now a considerable knowledge of the fauna of Yunnan, and to a lesser extent of Szechwan.

From a comparison of these faunas we can discover a significant difference between them. The number of common species is only 10% of their joint composition, while a zoogeographical analysis accentuates this dissimilarity even more. In Szechwan, the basic fauna is palaearctic (species of generaForficula L., Anechura Scudd. etc.) the tropical Indo-Malayan element being weaker (Dipaltys chinensis Hincks, Forcipula decolyti Borm., Eudohrnia metallica Dohrn, etc.).

In Yunnan, on the other hand,the tropical Indo-Malayan element is markedly predominent. Yet we do note a contribution by the palaearctic element (subgenus Gelotolabis Zach., Anechura Scudd., Forficula davida Burr etc.), among which, however, a number of species have still retained their primitive ancient connection with a tropical climate (Gelotolabis Zach., Anechura troquata Burr, etc.); the palaearctic nature of such species is difficult to unravel, and some of them (Forficula davida externa, subsp. n.) represent almost imperceptible transitions to species of Indo-Malayan origin.

In its Dermaptera Yunnan is most like Burma; they have 40 species in common. Yunnan has a number of common or closely related species with Assam and north Vietnam (Tonkin). Most characteristic of this whole territory is the group of species exclusive to it, these being Apachyus feae Borm., Adiathetus glaucopterus Borm. and Timomenus oannes Burr.

It is clear that the northern tropics of southeast Asia are now emerging as a single, though not completely homogeneous, zoogeographical region.

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SOME NEW SPECIES OF THE SUBTRIBE APHIDINA (HOMOPTERA, APHIDIDAE)

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The xerophilous aphids constitute a somewhat ecologically detached group among the vast number of aphid species as a whole.

Our own particular studies have been devoted to those xerophilous aphids which belong to the subtribe Aphidina. In this subtribe, the xeromorphic characteristics are more closely expressed than in other subtribes of the family.

The xerophilous aphids of the subtribe Aphidina are characterized by a distinctive complex of morphological peculiarities: the cellular cuticle which may be covered by a waxy bloom or by hairs; the abbreviate cornicles; the peculiar structure of the antennae, particularly the tips of their terminal segments; often also the peculiar structure of the caudal process and of the limbs, and the not infrequently encountered, powerfully developed clypeus (Mordvilko, 1901, 1914, 1919; Nevskii, 1929).

The finding of certain xeromorphic species of the subtribe Aphidina (and of other groups of the Aphidinae) in places which are far from deserts and which may have a relatively moist climate, leads us to suppose that the adaptations enumerated above, do not restrict their possessors to living in arid conditions (Bozhko, 1950a, 1950b, 1953a, 1953b, 1953c; Mordvilko, 1929; Shaposhnikov, 1952).

The material upon which this work is based is that in the author's private collection and in the Collection of the Zoological Institute AN SSSR.

Certain new species have been discovered in the course of our investigations; a description of these is given below. The type specimens upon which the descriptions are based are contained in the collection of the Zoologialc Institute AN SSSR.

Protaphis terrae-albae Ivanovskaya, sp. n. (Fig. 1)

APTEROUS FEMALE (in alcohol, from Artemisia terrae-albae, Malye Barskyi, May 18 1931, Luppoval). Body broadly elipsoidal, with a few stout hairs (on large tubercles). Eyes red; antennae and caudal appendage light colored; limbs brown; cornicles brown; cuticle reticulate over the whole body, with the individual cells of the reticulum evenly distributed, clearly defined and rather larger on the abdomen than on the thorax. Peripheral tubercles of prothorax, and those of first and seventh segments of abdomen are mamilliform; those on the seventh segment are smaller than those of the first abdominal segment. Spiracles circular, under an overhanging fold of the sclerotinized, stigmatal plate. Frons slightly convex, without antennal bosses, but with 2 hair-like processes, equal in diameter to the third segment of the antenna. Clypeus hemispherical, not extending as far as the anterior edge of the frons. Antennae 6-jointed, tegular, bearing on segment III, 3 (3-5) large rhinaria, on segment IV – 1 (1-2), and on segment V, a single rhinarium. Segment VI with 4 termnial setules, one at its extremity, the second slightly lower down and the other 2 lower still, a principal rhinarium on segment VI with 5-6 additional ones. Eyes normal, with 3 facets. Proboscis, extends to middle coxae. Limbs normal, with a few scanty hairs, and setules, on the first segment of tarsus. Coalescence of abdominal tergites

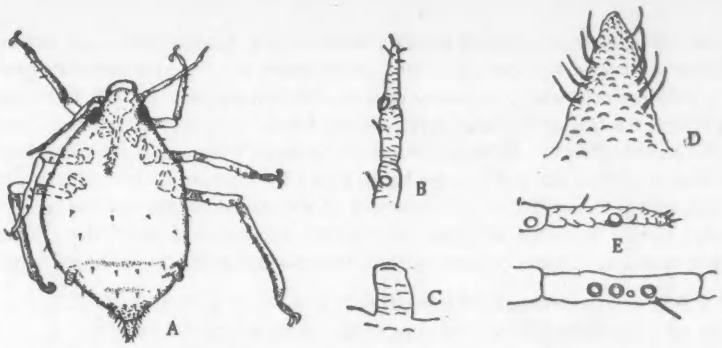

Fig. 4. Xerophilaphis berezhkovi Iv., sp. n. A) Apterus female; B) 6th antennal segment of same; C) cornicle of same; D) caudal process of same; E) 3rd and 4th antennal segments of winged female.

on the prothorax and on segments I and VII of the abdomen are mamilliform; those of the prothorax are wider than the third segment of the antennae; the tubercles on the seventh abdominal segment are only a third the size of those on the prothorax. Spiracles circular, situated under overhanging folds of the feebly sclerotinized stigmatal plates. Frons convex with feebly developed antennal bosses and having 4 hairs. Clypeus barely projects as far as the anterior margin of the frons, hemispherical, feebly sclerotinized. Antennae 6-jointed, segments V and VI tegular; a principal rhinarium on segment VI with 6 accessory ones; segment VI with 4 terminal setules; one atthe tip, 2 slightly behind it, and 1 lower down still. Eyes normal, with 3 facets. Proboscis extends back as far as the posterior coxae. Limbs with few hairs, setules on segment I of tarsus: 3-3-2. Coalescence of abdominal tergites normal. Cornicles cylindrical, short, not as long as caudal process. Caudal process triangular with 6 hairs laterally. Anal plate rounded with hairs.

Body 1.32 x 0.79 mm; antennae 0.73 mm (III 0.21 x 0.03, IV 0.11, V 0.13 mm, VI 0.09 + 0.05); proboscis III 0.09 mm, IV 0.11 mm; cornicles 0.08 x 0.05 mm; caudal process 0.15 x 0.09 mm.

Larvae pale green; 5-jointed antennae in instars I and II and 6-jointed in III and IV. Eyes red.

Turkmen. On Cynanchum acutum, in small colonies or singly, on stem surface, flowers and peduncles, associated with ants.

The species described differs from Brachyunguis cynanchi Nevs. (Nevskii, 1929) in the form of the body; in the shorter hind limbs; in being bicolored; in the shorter cornicles and the smaller number of hairs on the caudal process (6); moreover, in B. bicolor the frons is only slightly convex and therefore, the clypeus protrudes as far as the anterior edge of the frons, but in B. cynanchi Nevs. the frons is much strongly convex and therefore, the clypeus does not reach the edge of the frons.

Brachyunguis flavidus Ivanovskaya, sp. n. (Fig. 3)

FUNDATRIX (Peganum harmala, April 23, 1954, Tash Kapir). Body broadly ellipsoidal, greenish, covered with a faint powdery bloom; cornicles somewhat conicle. Otherwise, as in apterous females.

Body 1.75 x 1.17 mm; antennae 0.73 mm (III 0.19 x 0.03, IV 0.13, V 0.14, VI 0.01 + 0.07); proboscis III 0.07 mm, IV 0.10 mm; cornicles 0.06 x 0.05 mm (x 0.14); caudal process 0.15 x 0.10 mm.

APTEROUS FEMALE (Peganum harmala, May 21, 1954, Tash-Kepri). Body ovoid, green, greenish yellow posteriorly. Antennae and cornicles lighter, caudal process darker. Eyes reddish brown. Body covered with a powdery bloom, hairs scanty. Cuticular outgrowths forming a reticular pattern on thorax and abdomen, none on head. Peripheral tubercles on prothorax are broad, mamilliform; width of tubercles greater than diameter of third antennal segment; their height approximately $\frac{2}{3}$ diameter of third antennal joint; tubercles on first and seventh abdominal segments are mamilliform also, but, the tubercle on the first segment is only half the diameter of the third antennal segment, and that on the seventh segment is only $\frac{1}{3}$ of the diameter. Spiracles rounded, situated under overhanging fold of the stigmatal plate. Frons convex, with a few large hairs; 4 hairs on one side,

2 on the others; no antennal bosses; clypeus strongly sclerotinized, hemispherical not extending to the anterior margin of the frons. Antennae 6-jointed, the last 2 joints feebly tegular with darker colored tips; a principal rhinarium on the sixth segment with 6 accessory ones in addition; segment VI with 4 terminal setules; one at the apex, 2 just behind the first at the same level and the fourth somewhat lower down. Eyes normal, with a well-developed 3-faceted tubercle. Proboscis extends to posterior coxae, only slightly sclerotinized: segment IV pointed with 6 hairs at the apex and 2 at the base; 8 (6 + 2), segment III with 4 hairs. Hairs present on tibia; setules on the first joint of tarsus: 3-3-2. Coalescence of abdominal tergites normal, apart from the VII tergite which is rather sharply separated from the rest. Cornicles cylindrical, short with a scarcely discernible annulus, somewhat wrinkled. Caudal process conicle, with 8-9 elongate, lateral hairs. Anal plate almost square.

Body 1.61 x 0.88 mm; antennae 0.73 mm (III 0.22 x 0.03, IV 0.03, V 0.13, VI 0.09 + 0.07); proboscis III 0.07 mm, IV 0.10 mm; cornicles 0.07 x 0.05 mm; caudal process 0.15 x 0.09 mm.

Larvae lettuce-green; yellow, in the youngest instar (I and II) with 5-jointed antennae, in older instars (III and IV) with 6-jointed antennae.

ALATAE (of same). Body pyriform; head, thorax, abdomen yellowish green, but, darker in color than apterous form. Antennae brown, segment III with 4 (4 -6) secondary rhinaria. Wings light colored with slender interrupted veins; pterostigma grey. Segment VII and VIII of abdomen elongate. Otherwise as in apterous females.

Body 1.46 x 0.58 mm; antennae 0.73 mm (III 0.19 x 0.03, IV 0.15, V 0.15, VI 0.10 + 0.08); proboscis III 0.07 mm, IV 0.09 mm, cornicles 0.05 x 0.04 mm; caudal process 0.12 x 0.08 mm.

Nymphs green, sometimes yellowish, with 6-jointed antennae. Eyes red. Turkmen, on Paganum harmala sucking the sap from the veins at the base of leaves, or from the stems; associated with ants.

This new species is readily distinguished from Brachyunguis plotnikovi Nevs. and from other species found on Paganum harmala. The following species are known to occur on the latter plant: Brachyunguis harmalae Das. from the Punjab, (Das. 1918), B. plonikovi Nevs. from Central Asai (Nevskii, 1929), Pergandeida pegani Mim. from Africa (Mimeur), 1935). Comparing descriptions and diagrams of these species (and in the case of B. plotnikovi actual material) with the material of Brachyunguis flavidus, it can be asserted with confidence that the latter constitutes a new species, although closely related to B. harmalae Das.

B. flavidus n. sp. differs from B. plotnikovi Nevs.: 1) in color – the body of the latter species is green, with dark green patches around the spiracles, whereas, the body of B. flavidus is greenish yellow and in the region of the cornicles and caudal process is quite definitely yellow; 2) in B. plotnikovi Nevs. the fourth segment of the antennae is smaller than the fifth, whereas, in the new species the reverse holds; 3) the number and size of the rhinaria on the third antennal segment in the alatae differ in the 2 species; 4) the number of lateral hairs on the caudal process is 6 in B. plotnikovi, 8-9 in the new spcies; these differences, together with others, enable us to say that the 2 species are distinct.

B. falvidus n. sp. differs from B. harmalae as follows: 1) in the former the fourth and fifth antennal segments are of equal size, whereas, in the latter species the fourth is larger than the fifth; 2) in B. harmalae the tip of the fourth antennal segment is shorter than its basal portion to a greater extent than in the new species; 3) the fourth segment of the proboscis in B. hamalae has 2 hairs on its apex whereas in B. flavidus there are 6; 4) the lateral hairs on the caudal process in B. hamalae number 4-6, those of B. flavidus, 8-9.

The species from Turkmen is larger than that from Punjab. Our new species of aphis is closely related to the African species Pergandeida pegani Mim., but from the description and picture of the latter, it is possible to state that the 2 are distinct; in the African species the clypeus is poorly developed, the number of lateral tubercles is different – "on the sides of the abdomen there are a few small hemispherical tubercles" Mimeur, 1935: 34, the cornicles are expanded basally and are very wrinkled. This species from Turkmen is named B. flavidus because of its characteristic yellow color.

Xerophilaphis berezhkovi Ivanovskaya, sp. n. (Fig. 4)

APTERUS FEMALES (Salsola richteri, May 21 1954, Tash-Kepri). Body ovoid; flattened, with a few large hairs; light green in color. Eyes brown. Antennae, cornicles, caudal process light colored. Body powdery

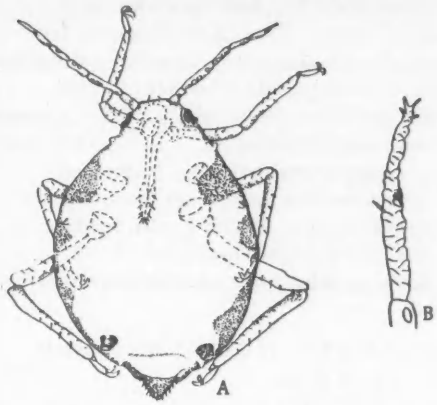

Fig. 1. Protaphis terrae-albae Iv., sp. n. A) apterous female; B) segment VI of antennae belonging to apterous form.

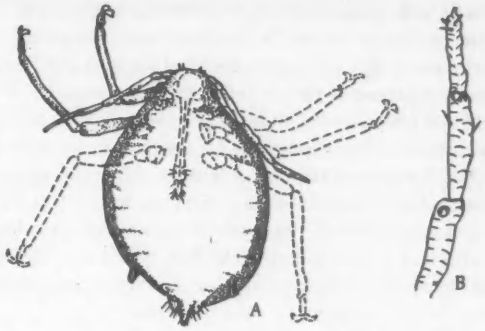

Fig. 2. Brachyunguis bicolor Iv., sp. n. A) Apterous female; B) VI segment of antenna in apterous female.

normal. Cornicles conical, sclerotinized, wrinkled, with distinctly colored annulation. Caudal process broadly conical, with 11-12 lateral hairs. Anal plate small, ellipsoidal.

Body 1.75 x 1.022 mm; antennae 0.87 mm (III 0.22 x 0.03, IV 0.13, V 0.16, VI 0.13 + 0.08); cornicles 0.07 x 0.12 mm (x 0.04); caudal process 0.15 x 0.20 mm.

ALATAE (of same). Body dark colored, antennae brown. Abdomen wider than thorax. Segment III of antennae with 5 (5 or 6) secondary rhinaria, segment IV with 4 (3-4) and segment V with 1 (1-3). Wing venation normal, veins feebly developed, and interrupted, pleurostigma yellowish. Rest of characteristics as in apterae.

Body 1.50 x 0.87 mm; antennae 0.87 mm (III – 0.21 x 0.03, IV – 0.15, V – 0.13, VI – 0.13 + + 0.09); proboscis III 0.08 mm, IV 0.14 mm; cornicles 0.05 x 0.10 mm (x 0.03). Caudal process 0.04 x 0.08 mm. Kazakhstan. On Artemisia terrae-albae.

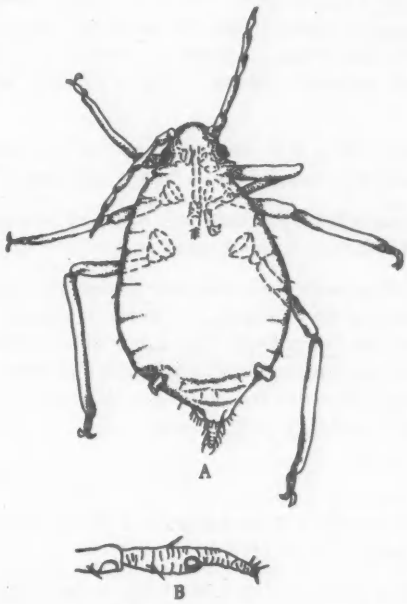

Fig. 3. Brachyunguis flavidus Iv., sp. n. A) Apterous female; B) VI segment of antenna in same.

The present sepcies may be distinguished from Protaphis artemisiae (Narz.) (Narzinkulov, 1949) by the presence of fewer hairs on the eighth abdominal tergite and also by the presence of secondary rhinaria in the apterous females. The antennae are longer than those of Protaphis artemisiae (Narz.) and the caudal process has a greater number of hairs.

Brachyunguis bicolor Ivanovskaya, sp. n.(Fig. 2)

APTEROUS FEMALE (from Cyanchum acutum, June 12, 1954 Tash-Kepri). Body short, fusiform in shape, grey with dark patches laterally. Antennae, limbs, cornicles of a lighter color, eyes brownish black. Body covered with a dust-like bloom. Cuticle reticulate; on thorax and abdomen the reticulate ridges are clearly defined, but, on the head the cells of the reticulum are represented only by faint scales. The peripheral tubercles

Cuticle with honeycomb pattern, but the reticulation of the head is obliterated. Peripheral tubercles conical on the prothorax but on the first and seventh segments of the abdomen the tubercles are mamilliform, the last 2 pairs being more strongly sclerotinized than the first; the peripheral tubercles of the first abdominal segment are larger than those of the seventh. Spiracles circular, situated under the overhanging fold of the sclerotinized stigmatal plate. Frons strongly protuberant, with poorly developed antennal bosses and possessing 4 hairs. Clypeus spherical, rarely projecting as far forward as the front edge of the frons, feebly sclerotinized. Antennae 6-jointed, the last 3 segments tegular. Principal rhinarium of segment VI with a ciliary crown and with 5-6 accessory rhinaria; tip of segment with 4 terminal setae; 1 at the apex, 2 just behind the apex and 1 lower down. Eyes normal with 3 facets. Proboscis sclerotinized extending to posterior coxae, segment III with 2 hairs, segment IV with 6 (4 + 2), segment III slightly wider than IV. Few hairs on tibia; setae on first tarsal joint: 3-3-2. Coalescence of abdominal tergites normal. Cornicles cylindrical faintly wrinkled without annulation. Anal plate circular, with a few elongate hairs.

Body 1.46 x 0.87 mm; antnenae 0.58 mm (III 0.15 x 0.03, IV 0.10, V 0.10 VI 0.10 + 0.06); proboscis III 0.07 mm, IV 0.10 mm; cornicles 0.07 x 0.04 mm; caudal process 0.17 x 0.11 mm.

Larvae with red eyes, 5-jointed antennae in first and second instars; emerald in first and second instars, yellowish green in third and fourth.

ALATAE (also found on May 20, 1954). Body very elongate, head black, thorax brown, abdomen dirty green; clypeus similar in size to that of the apterus females but darker in color. Segments III and IV of antennae darker than the others. Antennal segment III possesses 3 or 3 + 1 secondary rhinaria situated medially. Femur and top of tibia dark colored. Wings normal, transparant, with brown pterostigma. Otherwise, as wingless form.

Body 1.61 x 0.58 mm; antennae 0.58 mm (III 0.18 x 0.02, IV 0.11, V 0.11, VI 0.07 + 0.05); proboscis III 0.05, IV 0.07 mm; cornicles 0.05 x 0.04, caudal process 0.12 x 0.09 mm.

Nymphs brownish green with 6-jointed antennae and brown eyes. Turkmen. On Salsola richteri, on terminal branches, in small colonies, very active, associated with ants.

This species differs from Xerophilaphis salsolacearum Nevs. (Nevskii, 1929) in several repects , most of which concern the setae e.g., the different number of hairs on the frons, proboscis and caudal process. In addition, the clypeus in Xerophilaphis berezhkevi is better developed and relatively larger than in X. salsolacearum, and the former species has a completely different-shaped body and cornicles. The species is named in honor of the entomologist Rostislav Petrovich Berezhkov, who first directed the author in her studies of aphids at the V. V. Kuibyshev State University, Tomsk.

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THE EGGS OF TRUE BUGS (HEMIPTERA, HETEROPTERA)

V. PENTATOMOIDEA I.

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Investigations into the form and structure of shield bug (Pentatomoidea) eggs had already begun by the middle of the XIX century, and today there are good grounds for regarding the eggs of shield bugs as being the most intensively studied of all hemipteran eggs. In 1957, there were published separate descriptions of the eggs of 35 European species; the present work (V) together with a further paper in the press (VI), (in which there is an identification key for eggs belonging to shield bugs of European USSR) will increase that number twofold.

The majority of the shield bugs have a single generation per year and only in certain species (except for the genus Eurydema) are there two or more generations; two generations per year are to be found in certain species of the genera Aelia, Capocoris, Dolycoris, Bagrada, also in Legnotus picipes Fall., Cydnus aterrimus Frst. and possibly others, under the conditions prevailing in the southern parts of the USSR where three may occasionally occur.

In the families Scutelleridae, Pentatomidae and Plataspidae oviposition always proceeds pairing and is usually repeated several times; the females are able to oviposit repeatedly without copulation having taken place but, this situation increases the percentage of infertile eggs; representatives of the Acanthosomidae and Cydnidae have not been investigated in this respect.

In the course of their lives, females of the majority of acanthosomidae and cydnid species belong to native fauna lay several dozen eggs in a single oviposition, whereas, females of the families Scutelleridae, Pentatomidae and Plataspidae (most species) undergo several ovipositions, at each of which 6-14 eggs are produced. A few species, belonging to various families lay their eggs singly, either scattering them in detritus, placing them in crevices of the soil (Aethus, Ontonotscelis, Menaccarus, etc.) or attaching them to parts of plants (Sciocoris, Cyphostethus, Stagonomus, etc.). The intervals between successive ovipositions are either in the region of 2-5 days or are irregular, but in the Asopinae the interval is from 2-3 weeks, and is related to the duration of the gonotrophic cycle.

Shield bugs most often lay their eggs openly, and downy or hairy surfaces seem to be preferred; they are never deposited within the substrate, except in the case of the Cydnidae, where the females deposit their eggs in natural cavities or pockets of their own construction, despite the fact that as in other shield bugs, their ovipositors are almost vestigial. Only in the species Stagonomeus amoenus Brulle, in which the female deposits her eggs deep inside the calyx of sage flowers (Salvia) is there markedly elongate genitalia similar to those of the African species Birketsmithia anomala Lest. (Leston, 1956).

The number of eggs in each oviposition is for many species of shield bug, a multiple of the number of ovarian tubules (10, 12, or 14), except toward the end of the egg-laying period when the fecundity of the females drops; more rarely double ovipositions occur for example the 28 eggs of the Palomena. Observation has shown that the deposition of eggs one at a time, or in small groups, is a peculiarity characteristic of certain species. The disposition of eggs relative to the surface of the substrate is no less constant than their number; eggs may have their longitudinal axis perpendicular to the substrate, or they may have their longitudinal axis parallel to the substrate, although this latter condition, common enough in other Hemiptera, is rather rare in shield bugs;

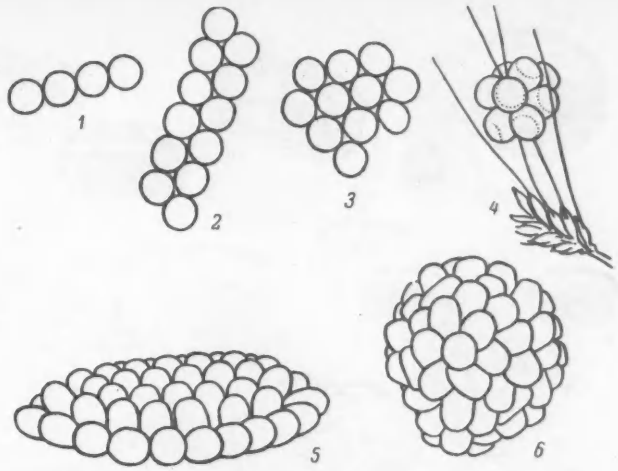

Fig. 1. Different types of oviposition among shield bugs. 1) Eggs laid in a single row (Psacasta neglecta H.-S.); 2) eggs laid in two rows (Eurygaster austriacus Schrck.); 3) eggs laid in checkerboard arrangement (Eurygaster maurus L.); 4) group of eggs on awns of wheat (Carpocoris Kol.); 5) one-layered group with inclined members at periphery (Elasmucha betula Deg.); 6) spherical egg mass (Canthophorus sexmaculatus Ramb.).

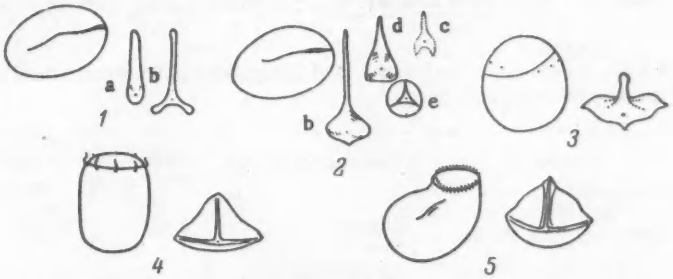

Fig. 2. Diagrams of eggs belonging to different shield bug families, their means of eclosion and the egg bursters. 1) Egg and egg bursters of Acanthosomidae: a) Elasmucha betulae Deg., b) Cyphostethus tristriatus F.; 2) egg and egg bursters of Cydnidae: b) Canthophorus dubius Scop., d) Legnotus picipes Fall., e) Thyreocoris scarabeoides L.; c) Sehirus bicolor L.; 3) egg and egg burster of Scutelleridae; 4) egg and egg burster of Pentatomidae; 5) egg and egg burster of Coptosoma scutellatum Geoffr.

furthermore, in eggs laid singly (or more commonly in eggs on the outside edge of the group) it may be found that the longitudinal axis is at an acute angle to the substrate (Fig. 1, 5).

The form of the egg masses and the arrangement of their constituent members show considerable diversity. When the eggs are numerous i.e., 50 or more, as in the Sehirinae, then the mass formed at one oviposition is usually spherical and the constituent member arranged haphazardly (Fig. 1, 6). In ovipositions glued to the substrate, the eggs are arranged in rows one layer thick and stand erect; only in the tropical subfamilies Tessaratominae and Dinidorinae are they deposited in a chain-like arrangement. Egg masses may be 1 or 2 or 3 or 5 rows in width

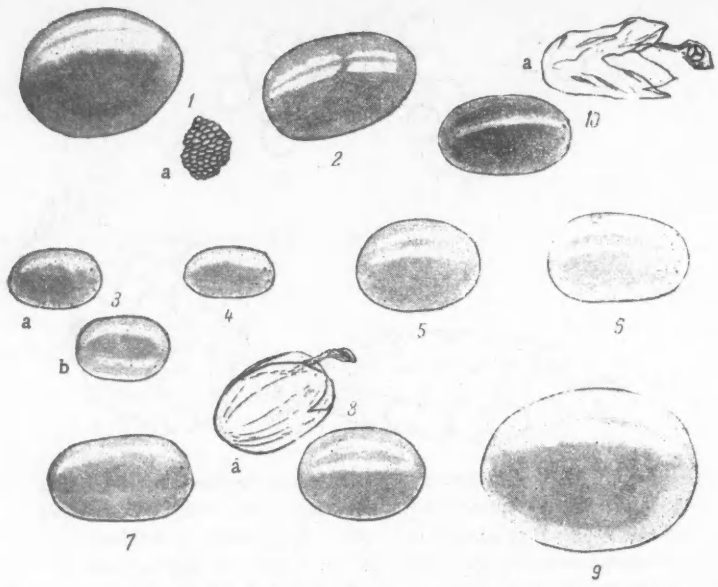

Fig. 3. Eggs of the Acanthosomidae and Cydnidae. 1) Cypostethus tristriatus F., a) structure of chorion; 2) Elasmucha betulae Deg.; 3) Legnotus: a) picipes Fall., b) limbosus Geoffr.;4) Ochetostethus nanus H.-S.; 5) Canthophorus sexmaculatus Ramb.; 6) Sehirus luctuosus Mls. R.; 7) Cydnus aterrimus Forst.; 8) Aethus nigritus F.; a) empty chorion with exuvium; 9) Stibaropus henkei Jak.; 10) Thyreocoris scarabeoides L.; a) empty chorion with exuvium.

Size of Eggs (in mm) at the Beginning and Completion of Embryonic Development (mean of 20 measurements for both phases)

Species	Dimensions of eggs	Immediately after laying	Before emergence of larvae
Phimodera nodicollis Burm.	Length	1.00	1.05
	Breadth	0.86	0.88
Eurygaster austriacus Schrnk.	Length	1.06	1.11
	Breadth	0.98	1.00
Eurygaster maurus L.	Length	1.05	1.19
	Breadth	0.97	1.10

(Fig. 1, 1-3). The form of the egg masses in certain species depends on the nature of the substrate employed by the female. Thus, females af the genera Odontotarsus, Carpocoris, Dolycoris, etc., lay their eggs in 3-5 rows on a wide surface but, on narrow surfaces e.g., stems awns of Gramineae etc. they glue their eggs in small clusters around the stem of awn (Fig. 1, 4) or occasionally they deposit them in two irregular rows. Multiserial (i.e., composed of many rows) ovipositions are rarely found on narrow surfaces; instead, in such situations we frequently find the eggs are glued together in 1 or 2 rows in a single plane and attached to the edge of the surface (Jalla dumosa L.).

Eggs are attached to the substrate by means of a mucous secretion produced by a special organ associated with the hind gut. When exposed to the air the mucus hardens but when in water it softens a little, although it is not completely soluble. The larvae, on emerging from the eggs, suck this mucous film, and in so doing, take into their intestines certain symbionts contained in the film.

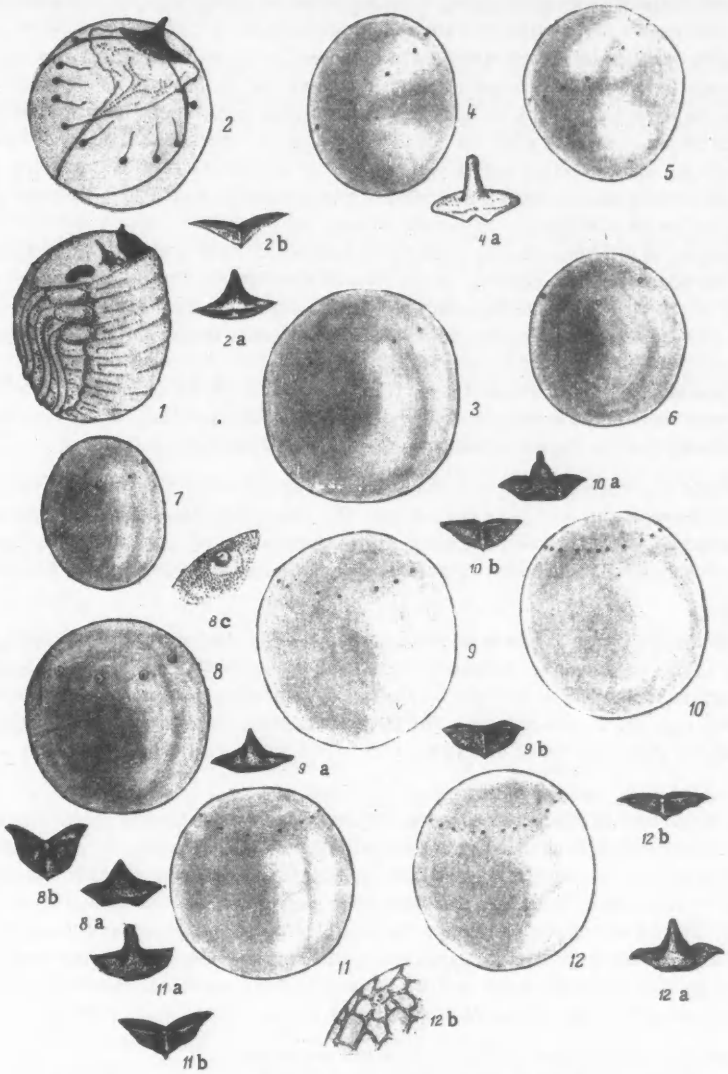

Fig. 4. Eggs of Scutelleridae. 1) Embryo of Eurygaster integriceps Put.ready to emerge from egg; 2) empty chorion of Odontotarsus purpureolineatus Rossi with exuvium; 3) O. robustus Jak.; 4) Odontoscelis fulignosa L.; 5) O. hispidula Jak.; 6) Phimodera nodicollis Burm.; 7) Psacasta neglecta H.-S.; 8) P. exanthematica Scop.; 9) Eurygaster integriceps Put.; 10) E. testudinarius Geoffr.;11) E. austriacus Schrnk.; 12) E. maurus L. (lettering the same for all diagrams): a) egg burster in anterior view, b) egg burster in dorsal view, c) part of chorion with a micropyle, greately magnified.

The fecundity of most shield bugs does not exceed 30-60 eggs per female, although in certain pentatomid pests which have been thoroughly studied, the fecundity varies between 50-70 eggs per bug,and in especially favorable conditions may attain 150-300 eggs. Such a high productivity, of the order of 200-300, is shown by certain Asopinae, which lay large numbers of eggs at a time and also by such mass predators, as Eurydema, which deposits a great many egg masses,each composed of few eggs.

The atmospheric humidity does not have any limiting effect on shield bugs, as in the majority of species the embryo is protected from a desiccation by a chorion of considerable thickness, about 20-40 μ (Southwood, [1956]). Eggs in which the width of the chroion does not exceed 2-4 μ, and in which the embryos would not be able to resist desiccation are laid in compact clusters and protected by the females (Sehirinae, Acanthosomidae) by being below the surface of the soil or in depressions at ground level where the atmospheric humidity is higher than that of the air generally; after the larva has emerged the shell of such eggs collapses as it cannot maintain its initial shape. Overwintering eggs have been noticed only in the species Picromerus bidens; these eggs require a drop in temperature to accomplish their embryonic development which has already commenced in autumn. In addition, to the arrangment and number of eggs per oviposition, other important features serve to identify eggs belonging to different species; among such features is the structure of the opening mechanism, which is related to the thickness of the chorion. In the Acanthosomidae and Cydnidae (Fig. 2, 1 and 2) the opening mechanism, as represented by the "egg burster", is small and only feebly sclerotinized (as in the Lygaeidae, Piesmidae and Pyrrhocoridae), whereas, in the Plataspidae and Pentatomidae it attains a greater size and thickness as a result of being strengthened by intersecting ribs which form a T-shaped pattern so characteristic of the vertex of the shield bug embryo within the egg (Fig. 2, 4 and 5). In the Scutelleridae because of the absence of any eclosion line and the relatively stout chorion, a peculiar, small but strongly sclerotinized, egg burster is developed, which is markedly thickened on all its surfaces (Fig. 2, 3).

The eggs of shield bugs open either by means of bilateral rupture of the chorion, as in certain lygeids, or by an annular split which separates off a false operculum. The latter may intersect the micropylar ring but is more frequently situated inside it, thus, resembling the true operculum of Cimicomorpha; the term "true operuclum" was unsuccessfully introduced by the author in an earlier paper (Puchkova [1955]) dealing with shield bugs.

The chorion of shield bug eggs is rarely smooth, more frequently it is covered with a reticulate sculpturing. The hexagonal areas of this reticulum are surrounded by smooth or downy ribbing. Sometimes the reticular pattern on the egg surface is ill-defined but rod-like, spinous or hooked projections occur irregularly over the chorion or are grouped together in rows or loops. The form of the projections is constant for eggs of a given species, although it varies within the limits of a single family and sometimes it differs between closely related genera.

The micropylar processes of shield bug eggs are very variable both in size and form; in several genera, they are practically indistinguishable without preliminary treatment. The processes may be barbed, tuberculate, columnar or figured. Inside the mirocpylar process there is a canal (the presence of which has been confirmed by Southwood [1956]) which is open at both ends. The barbed processes of the Cydnidae and Scutelleridae are characterized by "transverse" canals, parallel to the chorionic surface; the length of these canals is approximately equal to the distance between adjacent processes. All the micropyles occur at the broad end of the egg (which is far broader than in Lygeid eggs), and are more or less confined within limits of the false operculum The most elongate processes have been found in azopinid eggs.

The eggs of the superfamily Pentatomoidea fall into 3 main types.

I – Lygaeoid type. Smooth eggs of this type are peculiar to species of the Acanthosomidae and Cydnidae and are distinguished from the eggs of the Lygaeidae by the presence of small, ill-defined tuberculate micropyle (Fig. 2, 1 and 2); more rarely their surfaces are finely reticulare.

II – PentatomoidType. Eggs of this type are erect, cylindrical or barrel-shaped, more or less rounded at the apex and base, some times almost spherical. Their cephalic ends are surrounded by circlets of micropylar processes having various forms in different species; sometimes the micropylar processes are very small and distinguishable only after special treatment. Eclosion takes place by means of a false operculum. Their chorionic surfaces and downy or reticulate, rarely, smooth.

III – Coptosomoid Type. Eggs of this type are confined to the family Platasipiade. They are rather reminiscent of eggs belonging to the Rhopaloid type both in their form and distribution in double rows within the spicate egg-mass, but they differ in possessing a circular false operculum which cuts off 3-4 micropyles at the end opposite to that attached to the substrate (see Fig. 2, 5).

Despite their apparent lack of diversity in form, shield bug eggs differ markedly in their detailed structure.

Identification Key for Eggs of the Families Belonging to the Pentatomoidea

1 (4). Eggs of the Lygaeoid type with a thin chorion. Egg burster very small, slightly pigmented and poorly developed. They are deposited singly or more often in large groups; in the latter case they are always protected by the female.

2 (3). Eggs deposited on various plants, but mostly on trees or shrubs – Acanthosomidae.

3 (2). Eggs never found on plants, but, deposited in groups in soil crevices or singly on the soil surface – Cydnidae.

4 (1). Eggs of other types to the Lygaeoid, with a thick, stout chorion (chorion not curved or with rounded angles) and a well-developed egg burster. Egg mass never hidden away or protected by female.

5 (8). Eggs of the Pentatomoid type, spherical, barrel-shaped or cylindrical. Egg masses not spicate.

6 (7). Eggs almost spherical (globular or ellipical); false operculum not delimited by a groove from the rest of the chorion; the line produced by the larvae rupturing the chorion during its emergence from the egg passes through the micropylar ring. Egg burster short and massive (Fig. 2, 3) micropylar processes barbed – Scutelleridae.

7 (6). Eggs barrel-shaped or cylindrical; false operculum delimited by a grove from the rest of the egg; eclosion line extends as far as, but, does not pass through the micropylar ring. Micropylar processes more or less elongate, rarely almost indistinguishable, except for the egg is pigmented or covered with felt. Egg burster T-shaped – Pentatomidae.

8 (5). Eggs of the Coptosomoid type, micropylar processes numerous, figured. Egg burster T-shaped. Eggs arranged in biseriate, spicate masses – Plataspidae.

Eggs of the Family Acanthosomidae

The species of the family – mainly inhabitants of trees – lay their eggs on the leaves of the food plant; the sticky egg mass, for example, that of E. butula, hardens very slowly and remains tacky for a long time. The eggs of the Acanthosomidae have been found to be very similar to those of the Cydnidae, but differ from the latter in being deposited in a single layer, not in a spherical mass. The chorion is thick, (in Elasmucha it is about 4μ in width, according to Southwood, 1956) and is therefore able to protect the embryo from desiccation in a dry atmoshphere, a very necessary attribute as the presence of the female cannot change the microclimatic conditions and only serves to protect the egg mass from the direct action of the sun's rays, and to a lesser extent from the worst of the weather. In Cyphostethus, which lays its eggs singly or in small groups but, in which the female does not protect them, the chorion is considerably thicker. The empty egg shell of the genus does not collapse after the emergence of the larva, as does that of Elasmucha; it merely contract along the line of eclosion, in a manner similar to that of the egg shell of Pyrrhocoris apterus L.

The micropylar processes in Acanthosomid eggs investigated by the author, are very small and almost unrecognizable. They have no circular canal (cf. Southwood [1956]) and are arranged in a somewhat uneven ring. McGill [1942], noticed that under high magnification, the processes of A. haemorrhoidale appeared to be columnar and quite well developed.

The hatching of the eggs takes place by means of two splits which appear on opposite sides of the chorion, one split being longer than the other. The egg burster is very small and feebly sclerotinized; the degree of sclerotinization is directly proportional to the thickness of the chorion – in Cyphostethus the egg burster may be distinguished without difficulty in all exuviae, whereas, in Elasmucha it is difficult to discern and cannot be distinguished in every larval envelope. In both species, the egg burster is characterized by a strong development of the vertex process. The anterior edge of the egg burster in Elasmucha is markedly convex, whereas, that of Cyphostethus is slightly concave as a result of the development of short transverse processes, which give to it a Y-shaped form (Fig. 2, 1). The chorionic surface is smooth and has a more or less pronounced reticulate pattern made up of small hexagonal areas (Fig. 3, 1a).

The identification key given below is of preliminary rather than absolute significance, for the eggs of E. betula and C. tristriatus are the only ones actually examined by the author, knowledge of the other species being derived from the literature.

Identification Key for Eggs of the Acanthosomida

1 (6) Eggs deposited in groups and protected by females.

2 (3) All eggs in batch recumbent, bright green in color. Apex of egg not pointed. Micropylar processes, columnar, about 10 in number, only distinguishable at high magnification. Number of eggs per batch is 27-28; egg length 1.5 mm (McGill [1942]). Eggs found in early summer associated with hawthorn – Acanthosoma haemorrhoidale L.

3 (2) At least some of the eggs in the egg mass stand erect (with their longitudinal axis perpendicular to the substrate).

4 (5) All eggs in the egg mass erect, dark green in color, apex of egg pointed, micropyle is distinct. Number of eggs in batch 18-29. Egg length 1.0 mm. (McGill, 1942). On birch in early summer – Elasmostethus interstinctus L.

5 (4) Eggs in center of mass erect, those on the margin more or less inclined at an acute angle to the substrate, often recumbent. Freshly deposited eggs are a watery yellowish green color; later they become a definite yellow tint. Micropyles hardly discernible and of no account. Number of eggs in batch from 18-28 and even as many as 60 (Fig. 3, 2). In May to early June on birch leaves, more rarely alder (Fig. 1, 5) – Elasmucha betulae Deg.

The eggs of this species are very similar to those of E. ferrugata F. (Strawinski, 1951), except that those of the latter species are of a bright green tint, and they are found from May to August on the lower surface of bilberry leaves Vaccinium myrtillus and leaves of some other berried shrubs.

6 (1) Eggs laid singly, or if in groups, no more than 10 to a batch; never protected by female. Of oval shape, sometimes slightly tapered anteriorly; green, the color not changing as embyro develops. Microplyes barely distinguishable. Reticulate pattern of chorion distinct individual cells of pattern slightly convex. Egg length 1.04, breadth 0.8 mm. (Fig. 3, 1). In May-June (Crimea) on Juniperus and Cupressus species – Cythostethus tristriatus F.

Eggs of the Family Cydnidae

The family Cydnidae is divisible into 3 well-defined groups, the Corimelaeninae, represented in the USSR by a single species Thyreocoris scaraboides L., the Cydninae and the Sehirinae; and though the adult and larvae stages differ markedly between the 3 subfamilies, their eggs are very similar. However, the author has found (as a result of examining data at her disposal) that the form of the egg burster is quite variable within the limits of this family and is therefore, a better criterion for identifying the eggs of different species than the shape of the eggs themselves, (cf. Fig. 2, 2, b-e).

Females of the Cydnidae deposit their eggs either singly or as small groups in soil crevices; if however, the soil is neither loose nor crumbly, the females make little tunnels for their eggs (Legnotus limbossu). None of our native species glue their eggs to the aerial parts of plants and in this they differ from the American species Corimeleana virillis McAtee, which attaches its eggs to the branches and petioles of Nicotiana, according to Lattin [1955].

The eggs of Sehirinae are deposited in clusters and glued together by a transparent secretion of the female, this secretion is a pale yellowish brown color and fills the interstices between the eggs. Thomas [1954] described the eggs of L. limbosus as adhering together by means of peculiar sticky fibers which project from the base of the eggs and are secreted by the abdomen of the female during the deposition of each egg. The author has never succeeded in observing the production of sticky threads by females of this species during oviposition but their eggs certainly adhere less firmly than those of Sehirus and Canthophorus.

The duration of the oviposition process varies a great deal. Korinek [1940] found that the females of Sehirus luctuosus took 2 days to deposit a large egg mass with intervals of nonactivity. The same author observed females of Canthophorus sexmaculatus during oviposition and found that they completed the process in 3-3½ hours, during which time they ceased oviposition on one or two occasions and partook of a brief meal.

The brooding instinct is not shared by all species of the Sehirinae in an equal measure. S. luctuosus transfers the egg mass to between its limbs and holds it in position with the proboscis. If the eggs of this species are left unattended by the female they readily become moldy or desiccate. S. sexmaculatus merely guards its eggs without brooding over them; the female protects them from insect predators and keeps them free from foreign matter. With proper care, the eggs of this species can be removed from the females and their development will take place normally in cages. The females leave the egg mass in order to feed; this they do frequently, at the beginning of incubation and more rarely toward the end.

Larval emergence from the eggs takes place simultaneously in S. luctuosus according to Korinek [1940] who observed that most of the larvae left the eggs immediately or with only a short delay, whereas, in other species, e.g., C. bicolor he found that the period of emergence extended over 12-15 hours and all the larvae remained within the eggs for several hours. Soon after the emergence of the larvae from their eggs, the females perish (Sehirus, Canthophorus) but, in L. limbosus the females survive until the larvae have attained their third and frequently their fourth instar. The deposition of a single egg mass, containing all the eggs, and its protection by the female is a peculiarity of the Sehirinae and obviously related to the transfer to symbionts to the larvae by the adult female (Schorr, 1957); the remainder of our native shield bugs lay their eggs singly and take no interest in their fate,and this also is the case in Thyreocaris, which sometimes lays its eggs in small groups.

Eggs of most terrestrial shield bugs are to be found during the first half of the summer under natural conditions, and only in certain species is there a second brood which lays its eggs in the second half of the summer (Cydnus aterrimus, L. picipes).

The micropylar processes of cydnid eggs are very small and poorly developed; in order to render them visible in living eggs, it is necessary to stain the latter with methylene blue when the area around the micropyle is stained less intensely than the rest of the chorion. The number of micropyles in eggs of the same species, even among those laid by a single female, is not constant and varies from 5 or 6 to 12.

The chorion of the egg is devoid of color, the apparent color of the egg being that of the embryo within – reddish, white, yellowish; the empty egg shell from which the larva has emerged is usually milky white and iridescent. The chorionic surface is smooth, glossy or dull.

The egg burster in terrestrial shield bugs is small and may be difficult to distinguish; it occurs on the vertex of the embryo and exhibits great diversity of form. In Th. scarabeoides L. (Fig. 2, 2 e) it is round; it may be furnished with a more or less elongate out growth of the vertex (Fig. 2, 2 b, c, d) and be triangular in outline as in L. picipes (Fig. 2, 2 d) or in C. bicolor, according to Leston and Southwood [1954]. In its Y-shaped form (Fig. 2, 2 c), the bifurcation of the egg burster is more acute and the arm of the vertex shorter then in Cyphostethus tristriatus (Acanthosomidae). The circular egg burster of Th. scarabeoides has a triangular ridge and this is of particular interest in view of the fact that a simliar circular egg burster, but, without any ridge, has been described for the Calfornian species Corimelaena virilis McAtee by Lattin in 1955.

The rupture of the chorion for the emergence of the larva may be unilateral as in Aethus (Fig. 3, 8 a), bilateral as in Canthophorus or triradiate as in Thyreocoris (Fig. 3, 10 a), where one or 2 rays may be more strongly marked than on others.

Identification Key for Eggs of the Cydnidae

1 (16) Eggs deposited in large clumps (consisting of 30-40 or more) in soil crevices variously covered; in loose, crumbly soil, they are deposited in tunnels at no great depth below the surface. Egg masses protected by females.

2 (7) Eggs glued together in loose balls of irregular construction; size of egg less than 0.65 mm.

3 (6) Eggs of a milky white, white or cream color. Egg masses occur in soil crevices, near to plants of bedstraw (Galium).

4 (5) Egg masses occur in rather moist places shaded by woody plants. They consist of 30-40 eggs, brooded over by a single female. Length of egg 0.64, width 0.44 mm. (Fig. 3, 3 b). In June and July on the fringe of woodland, in parks, near copses and similar places where Galium aparine grows – Legnotus limbosus Geoffr.

According to Thomas, 1954, the egg length of this species is 0.75 and the width 0.42 mm; the food plants of Legnotus limbosus are Nepeta hederaceae and Lamium purpureum. Other food plants given for this species are Galium spurium (Korinek [1940]), Stachys sylvaticus (Gulde [1921]) and Lamium album (Cobben [1953]).

5 (4) Eggs laid in exposed, dry situations. Each egg mass contains 60-80 eggs, and is protected by the two bugs. Length of egg 0.58, width 0.38 mm. (Fig. 3, 3 a). Found in May and June, in July and August on dunes, hillocks, the slopes of ravines and such places where Galium verum and G. ruthenicum occur – Legnotus picipes Fall.

6 (3) Eggs very glossy, milky white in color. Eggs masses occur in tunnels under a shallow layer of sand. Length of egg 0.60, width 0.26 mm (Fig. 3, 4). From June to August, almost exclusively under sand dunes under Echium vulgare, Potentilla, Galium and other plants – Ochetostethus nanus H.-S.

7 (2) Eggs glued together in a dense ball, usually rather large.

8 (9) Length of egg about 0.48 and width 0.36 mm. Egg masses elongate, about 3 cm long, consisting of 40-50 eggs. From May to July in various dry places: steppe-dunes, hillocks, the slopes and tops of hills and in the sandy shell-rock soils on the shares of the Black Sea and Sea of Azov; always in the vicinity of Thesium ramosum – Canthophorus dubius Scop.

9 (8) Eggs larger, about 8.0 mm or more in length.

10(15) Eggs usually oval or slightly expanded posteriorly. Not found near spurge (Euphorbia).

11 (14) Eggs whitish yellow turning pinkish before hatching.

12 (13) Eggs smaller, or oval shape; egg masses flattened consisting of 40-60 eggs (according to Korinek, 1940, of anything up to 161 eggs). In June and July on the edge of vegetable plots, the sides of ditches, on the borders of woodland and in similar places with sandy humus soils, near to Ballota ruderalis and other species of the same genus – Canthophorus sexmaculatus Ramb.

13 (12) Eggs larger, elongate, oval or ovoid in shape; egg masses rounded, consisting of 30-60 eggs. Egg length 0.90, width 0.60 mm. In June and July on the edge of woods, copses and also hillsides; near to Melampyrum – Canthophorus biguttatus L.

14 (11) Eggs white, with a faint yellow tint which changes to orange in time, oval or ovoid in shape (slightly expanded posteriorly). Egg masses spherical consisting of 40-45 eggs. Egg length 0.90, width 0.53 mm (Fig. 3, 6). In June and July on recent deposits near to various species of the Boraginaceae, e.g., Lappula, Anchusa, Echium, etc. – Sehirus luctuosus Mls. R.

The eggs of S. morio L. have similar characteristics; it is possible that further acquaintance with the form of their respective egg bursters will enable us to use this feature to distinguish between the eggs of Sehirus morio and S. luctuosus. According to the literature (Korinek [1940], Stokes [1950] and others) the eggs and egg masses of Canthophorus bicolor are also similar to those of S. luctuosus, although the former are significantly larger (1.0 mm long and 0.50-0.75 mm wide) and initially are a creamy color which gradually changes to orange.

15 (10) Eggs cylindrical, with rounded ends; maximum width of the egg lies in front of the middle, near to the cephalic pole, but at the beginning of development there is a slight shrinkage in this region. Color of eggs a rather watery white, chorion dull and not glossy, egg mass consists of 40-50 individuals. Egg length 0.92, breadth 0.51 mm (Fig. 3, 7). In May and June and again in July and August in sandy and loamy soils in steppe country, near to spurge plants (Euphorbia spp.) – Cydnus aterrimus Forst.

16 (1) Eggs occur singly or in small groups (of 3-6 eggs) in the soil. Egg masses never protected by females.

17 (20) Eggs laid singly and opening by a unilateral or bilateral split; white or yellow in color.

18 (19) Of smaller size; chorion with a slight luster, occasionally with very faint wrinkles; egg length 0.83, width 0.60 mm. (Fig. 3, 8). In May and July in various soils (mostly sandy) – Aethus nigritus F.

19 (18) Larger; chorion quite smooth, glossy and iridescent. Egg length 1.37, width 0.93 mm (Fig. 3, 9). In May and June around the roots of Elymus giganteus, Carex on sand dunes, especially those of the shore of the Sea of Azov, Caspian and Black Seas – Stibaropus henkei Jak.

20 (17) Eggs deposited in small groups (3-6) or singly but near to each other; eggs open by triradiate split. Egg reddish (empty shell milky white); chorion without luster and with faint longitudinal ribbing down the sides, together with well-developed, warty micropylar processes. Egg length 0.85, width 0.49 mm (Fig. 3, 10). In May and June at the edge of woodland, fields, parks and copses, etc.,where Viola tricolor grows – Thyreocoris scarabeoides L.

Eggs of the Family Scutellidae

The females of those members of this family which occur mainly in litter (Phimodera, Odeontoscelis) lay their eggs singly; the latter bear a striking resemblance to grains of quartz sand and are not attached to the substrate although small particles of soil or plant remains may adhere to them. In other species (Eurygaster, Psacasta, Odontotarsus) the eggs are deposited in 2 or more rows, either on living or dead parts of plants, particularly near the base, or when weather conditions are unfavorable, directly onto the soil.

The chorionic surface of eggs belonging to the Scutelleridae is smooth; in the Psacasta exanthematica it is glossy whereas in Odontoscelis the surface is dull; in Eurygaster, Odontotarsus etc.,the egg is almost spherical in form, whereas in Psacasta neglecta and Odontoscelis fuliginosa it is ellipsoidal. Usually both poles of the egg are equally rounded, only in Odontoscelis hispidula is the posterior end of many eggs slightly more pointed than the anterior thus giving the egg an "ovoid form". The curvature of the chorion is normally the same over the whole surface, but in O. fuliginosa and to a less extent in Eurygaster testudinarius the dorsal side is somewhat flattened (Fig. 4, 4, 10). A network of polygonal areas separated by short upgrowths from the chorionic surface, may be seen on the surface of the majority of eggs belonging to this family (Odontoscelis, Odontotarsus, Eurygaster, Ps. neglecta, etc.). This shown is in Fig. 4, 12 e. Near to the posterior end of the egg these upgrowths cease to form continuous ribbing, and appear rather like a dotted line, finally disappearing altogether. More rarely the chorionic surface is without projections (Phimodera) or it may be covered by a few raised spots, grouped together here and there into clusters (Psacasta exanthematica). At magnifications of 100-150 each of these raised spots is seen as very short tubercle (Fig. 4, 8 e).

The chorion of the Scutelleridae is never pigmented and the color of the egg is determined by its contents; usually just after they have been laid the eggs are white (Phimodera, Odontotarsus) or green (P. exanthematica, Eurygaster). Species of the genus Eurygaster are characterized by having their eggs of varying color depending on the degree of development of the embryo. In other species the color does not change with the development of the embryo, but the egg does darken somewhat or turns a pinkish shade of the original color.

The eggs of Ph. nodicollis, E. maurus and E. austriacus enlarge somewhat in the course of their development, as may be seen from the table.

Coincident with the enlargement of the egg there is a change in the physical properties of the chorion, which toward the end of embryonic development, becomes brittle, with the result that – as A. A. Makhatin suggested to me in a personal conversation – an obtuse-angled, annular tear is readily formed by pressure from within the egg. According to Southwood, 1956, this tear takes place along a line of structural weakness, which however cannot be distinguished from the rest of the chorion, and apparently results from the tension set up in the egg shell by the developing embryo's increase in size.

The chorion of the Scutelleridae is dense and its thickness is of the order ot 30μ, according to Southwood, 1956, so that after the larva has emerged, the translucent egg shell always maintains its former shape. It is then found that the annular fracture line almost or entirely encircles the chorion. In species of the genus Eurygaster, the portion of the chorion isolated by the split is rarely circular in outline but is more usually oval or ovoid. The line along which the egg ruptures lies approximately parallel to the transverse plane of the egg and always intersects the micropylar ring more or less obliquely (in Odontoscelis it lies at an angle of almost 45° to the transverse plane of the egg). The distance between the individual micropyles is not constant and in the African genus

Chrysocoris the micropyles, in certain places, may even lie in 2 distinct rows, according to Southwood [1956]. In isolated eggs belonging to the species of Eurygaster, Odontoscelis and other genera, the micropylar processes are not arranged in a circle but in an oval or ovoid formation. The micropyles of the Scutelleridea are small nad mamilliform; they have very long transverse canals which are clearly visible by transmitted light in the empty chorion, where they may be seen to coil spirally toward the center of the egg (Fig. 4, 2). An accurate count of the number of micropyles is, in most cases, a difficult undertaking especially in eggs where the embryo has already begun to develop, for in using the methylene blue technique to count the micropyles, their number is found to vary even among eggs laid by a single female.

At first glance, the egg bursters of the Scutelleridae appear to be quite different from those of other families, especially when they are examined detached from the embryo. Careful comparison of their form and positions on the embryo's head (Fig. 4, 1), however, suggest that they are derived from the triradiate type with an approximately equal development in length of the vertical and transverse processes. They are relatively small, and black all over (Eurygaster, Psacasta), more rarely a light brown shade and quite colorless in places (Odontoscelis, Phimodera, Odontotarsus); they have the general form of a wing-shaped plate, situated in the frontal plane and bearing a backwardly directed, blunt tooth, which corresponds to the process of the vertex; this particular "tooth" occurs on the anterior edge of the plate, is directed upward and is clearly observable (Fig. 4, 8-12 b). The rupture of the chorion is achieved by the larva directing the apex of the "tooth" against its inner surface. The author was able to make a detailed observation of this process in 1952, through the almost transparent chorion of E. testudinarius. Before the larva emerges, energetic pulsations of fluid commence in its head region (similar pulsations have been described in the head fluid of many other insects) and in addition, the larva aims a series of blows, " banging", as it were, the inside of the chorion. From time to time, the larva turns slightly through an angle of 1-2° from right to left (usually during a "rest" period when the "tooth" is not in contact with the chorion). The "egg burster" usually strikes the chorion along the inside of the micropylar ring and in this spot a short, white furrow appears, which after several more blows elongates rapidly and ultimately splits off a piece of the chorion. Sometimes, especially when the eggs are kept in cages along with the adults, parts of them are found to be partially or almost completely evacuated (such eggs may be readily distinguished by freezing them, when a minute icicle appears at the point where they have been punctured). If only a small part of the contents has been sucked out the embryo is able to begin development and may even complete it. It is then possible to see a larva occupying only half the egg volume, but there is no trace of the puncture on the chorion. Such a larva cannot escape from the egg as it is too small to exert sufficient force against the chorion to rupture the latter, moreover the egg burster strikes not against the edge of the micropylar ring but at its center.

On emerging from the egg, the normal larva immediately begins to suck the film of symbionts infecting the egg surface. The instinct to suck the egg shell is so firmly ingrained that, on being transferred to other branches of eggs (either empty or containing embryos) the larva will continue to suck their surfaces.

Identification Key for Species of Scutelleridae

1 (8) Eggs laid singly, scattered in the upper layer of soil and over its surface. Egg burster faintly colored. Color of egg whitish later turning to yellowish cream, but never green.

2 (7) Eggs oval or ovoid in shape; chorion with a dense honeycomb pattern of hexagonal or pentagonal cells. There are no brown, hardening drops of secretion on the chorion but grit particles are often glued to it; these may be washed off with water.

3 (6) Micropylar ring markedly slanting, extending from just below the apex of the egg on the dorsal side to near its middle on the ventral side. Boundary of false operculum not distinct, and the splitting of it during eclosion extends almost to the equator of the egg. Micropyles clearly defined.

4 (5) Eggs with a glassy translucence. Smaller than most. Micropyles 15-20. The egg clearly tapers from its middle to its posterior end; chorionic network sometimes marked by dots. Length about 0.94-0.98, breadth 0.81-0.84 mm (Fig. 4, 5). In June-August in clay or "black earth" soils, under various shrubby plants, in the southern European parts of the USSR – Odontoscelis hispidula Jak.

5 (4) Eggs dull white. Larger than the preceding ones. Micropyles 8-10. Dorsal side of the egg clearly depressed; chorionic network distinct. Length about 1.0, breadth 0.89 mm (Fig. 4, 4). In June-August under various shrubby plants on diverse soils – Odontoscelis fuliginosa L.

The egg of O. dorsalis F. is very similar to that of the above species, but the surface of the former appears dull because of the presence of a thick mass of "stippling". Length about 0.90, width 0.78 mm.

6 (3) Micropylar ring somewhat slanting. False operculum clearly defined with its boundary lying half above and half below the micropylar ring, and very close to it. Micropylar processes distinct, glossy, barbed and arranged in a circle equal distances apart; 13-18 in number. Eggs dull, yellowish grey, at the beginning but turning a pinkish color before hatching. Honeycomb pattern on chorion consisting of small cells. Length 1.25 breadth 0.99 mm. In July-August, from 1-4 at a depth of 0.5-10 cm in loose sandy soil near to grasses particularly Agropyrum – Irochtorus lanatus Pall.

7 (2) Eggs almost spherical. Chorion smooth, without reticulate (honeycomb) pattern. Micropylar ring, formed from 7-10 processes, distributed almost parallel to the transverse plane of the egg and confined to the cephalic quarter of the chorion. Drops of hardened secretion to which soil particles are fimly attached occur near to one of the poles of the egg or more rarely to its lateral surface. Egg length about 1.0-1.05, width 0.86-0.88 mm (Fig. 4, 6). In May-July, in sandy soil under thyme (Thymus serpyllum) and other plants – Phimodera nodicollis Burm.

Very rarely, and usually associated with damp soils, the eggs are laid on plant stems in groups of 3-4 at a height of 5-8 mm above soil level.

8 (1) Eggs laid on different parts of plants or their remains in groups of 14 per oviposition. Egg burster usually entirely black or dark brown, more rarely with certain portions of it not colored.

9 (12) Eggs slightly glossy, whitish, sometimes becoming pinkish but never green. Chorion transparent with a coarse honeycomb pattern of polygonal cells.

10 (11) Eggs arranged in 3-5 staggered rows (checkerboard effect). Micropyles 8-10, poorly visible. The egg burster has several colorless parts along the anterior edge and at the base of the vertex process. The "tooth" of the egg burster is set back a little way behind the anterior margin (Fig. 4, 2). Length about 1.40, width 1.14 mm. In June-July on the lower surface of sage (Salvia) leaves and the basal leaves of other plants – Odontotarsus purpurealineatus Rossi.

11 (10) Eggs glued in heaps around slender, stem fragments and the stems of living plants near to the soil. Micropyles impossible to count (almost indistinguishable). Length about 1.36, width 1.25 mm. In June-July, in the Crimea – Odontotarsus robustus Jak.

12 (9) Eggs green, but turning either yellow or a pinkish color as they develop. (In the latter case, their length is less than 1 mm.)

13 (16) Chorion of egg is without any reticulate (honeycomb) pattern and the eggs are small and arranged in a single row.

14 (15) Eggs larger, length about 1.05, width 0.95 mm. Eggs in batches of 3 or 4, more rarely in 2 rows. Chorion with a few punctate tubercles (visible at a magnification of 140). Micropyles 8-10, rather clearly visible, whitish of truncately conical form (x 140). At the end of their development the eggs turn yellow (Fig. 4, 8). In June on the lower surface of living and dead leaves, bracts, etc., of Lappula echinata, Borago officinalis, Anchusa and other members of the Botaginaceae – Psacasta exanthematica Scop.

15 (14) Eggs smaller than those of the last species, about 0.98 mm in length and 0.85 mm in breadth. Arranged in a single row consisting of 2-4 eggs per oviposition. Chorion with a reticulate (honeycomb) pattern. Micropyles 8-10; in eggs containing embryos these are poorly visible and have barbed processes (seen at magnifications of 140). The eggs turn a pinkish color toward the end of their development (Fig. 4, 7). In June-July on Lappula echinata, more rarely on Anchusa, toward the top of the plant on leaves and generative organs – Psacasta neglecta H.-S.

16 (13) Chorion with a coarse honeycomb pattern. Eggs never arranged in a single row and never turning pink – Eurygaster Lap.

The eggs of this genus are extremely similar, and their identification cannot be made with confidence unless they are kept until such time as they hatch into larvae; however, they do differ somewhat in their

number and disposition within the egg mass, the number of their micropyles, and particularly in the form of their egg bursters, although all these characteristics are highly variable among eggs of a single species. In typical cases the eggs of Eurygaster spp. can be identified as follows.

1. Eggs most usually arranged in 2 rows. Micropyles 16-19 – 2.

– Eggs most usually arranged in 3 or 4 rows. Micropyles numerous – 3.

2. Eggs small, length about 1.05-1.19, breadth 0.97-1.10 mm. Micropyles 16-19, often 17 (67% of eggs). Egg burster triangular-sagittate (Fig. 4, 11 b) when viewed from above, whereas when viewed from the front its posterior edge is about straight (Fig. 4, 11 a). Arrangement of eggs in mass often irregular – E. austriacus Schrnk.

– Eggs larger, length about 1.22, width 1.11 mm (as measured in material from alcohol). Egg burster almost rectangular in dorsal aspect (Fig. 4, 9 a); the process of the vertex is shorter than in the other species (Fig. 4, 9 b). Micropyles 16-18, often 17 (84% of eggs). Arrangement of eggs usually regular – E. integriceps Put.

3. Eggs smaller than those of last species, length about 1.05-1.11, breadth 0.98-1.00 mm. Egg burster wing-shaped when viewed from above, narrow (Fig. 4, 12 b), in anterior aspect its posterior margin is approximately arciform (Fig. 4, 12 a). Micropyles 16-22, most usually 21 (54% of eggs) – E. maurus L.

– Eggs larger than those of last species, length about 1.17-1.20, breadth 1.08-1.11 mm. Egg burster almost triangular in dorsal aspect (Fig. 4, 10 b), but when viewed from in front the posterior margin is strongly concave (Fig. 4, 10 a). Micropyles 20-23, most usually 21 (60% of eggs) – E. testudinarius Geoffr.

SUMMARY

Shield bugs usually deposit their eggs in batches in the soil, on the surface of the soil or on plants, herbaceous or arboreous; only a few species deposit solitary eggs. The females of most species of Acanthosomidae and Sehirinae of the European part of the USSR are capable of depositing only one large egg mass (containing from 20-30 to 50-80 or more eggs) during their life, but there are many species in which several egg masses are deposited,. the number of eggs in each egg mass being a multiple of the number of ovarioles in the female (8, 10, 12, 14, more rarely 28); the egg masses of Asopinae frequently contain 50-90 and still larger numbers of eggs. The duration of embryonic development in shield bugs varies from species to species, and depending on climatic conditions, within the range of from 3-4 to 15-20 days. Only a few species are two- or three-brooded. Only Picromerus bidens hibernates as egg.

The eggs of shield bugs are classified into three types (Lygaeoid, Pentotomoid and Coptosomoid) according to their shape and certain other characters.

Besides the key for the determination of the family appurtenance of the eggs of shield bugs, the article contains the brief general characteristics of the eggs of the families Acanthosomidae, Cydnidae and Scutelleridae and the keys for the determination of the species appurtenance of the eggs within these families.

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EUSPHALERUM (ABINOTHUM) BERGI KIRSCHENBLATT, SP. N.
A NEW STAPHYLINID WITH LONG ELYTRA (COLEOPTERA, STAPHYLINIDAE)

Ya. D. Kirshenblatt

Eusphalerum (Abinothum) bergi Kirschenblatt, sp. n.

Yellowish red, shining; abdomen dark brown with reddish apex; tips of antennae dark.

Head transverse with large, bulging eyes occupying almost the whole side of it. Vertex in front of ocelli with small alveoli, continuing anteriorly as shallow frontal sulci which are connected between the bases of the antennae by a shallow, transverse depression. Between the inside edge of the eyes and the corresponding frontal sulcus there are numerous, fine, longitudinal wrinkles diverging fanwise from the bases of the antennae (the external wrinkles converge toward the inside of the eyes but the external ones reach as far as the ocelli). Upper part of head delicately, but fairly sparsely, punctured, the distance between the punctuations often exceeding the diameter of the pits. Frons between antennae without punctuations. Between the dots the head is covered with exceedingly fine, transverse wrinkles which, in the posterior portion of the head, change to delicate shagreen. Antennae well proportioned, with an often well-defined 3-jointed club, scarcely reaching the hind margin of the pronotum. The 1st antennal joint long and comparatively large, more or less cylindrical; 2nd joint considerably thicker than the succeeding joints; 3rd joint hardly longer than the 2nd, almost as long as 4th and 5th and sometimes longer and narrower than 6th and 7th joints; 8th-10th joints conical, expanding toward the tips, their length slightly exceeding their breadth; 11th joint spindle-shaped, almost twice as long as 10th.

Pronotum distinctly narrower than elytra, the contraction being a little stronger anteriorly and posteriorly with anterior and posterior angles fairly rounded. Width of pronotum about one third greater than its length. Disc of pronotum convex with an oval depression on the posterior half of each side and a shallow, triangular depression in front of hind margin; side of pronotum from the middle to the hind angles is impressed over a wide area. Surface of prontoum very densely and finely punctured and with short, yellow pubescence, delicately shagreened between the punctures. Thorax impunctate but with delicate shagreen.

Elytra covered with a thick and quite delicate punctuation and very short, fine pubescence; between the punctures they are perfectly smooth. Punctuation of elytra twice as coarse as that of pronotum, the intervals between the punctures being almost equal to their diameter.

Abdomen strongly contracted toward the tip, the hind margin of each preceding segment tooth-like and extending beyond the anterior margin of the following segment; because of this the lateral margins of the abdomen have a serrate outline. Tip of abdomen pointed. Abdominal tergites quite thickly and finely punctuated, the punctures bearing short, yellow hairs. Anterior abdominal sternites with dense, fine punctuation, 6th sternite much more sparsely punctuated, 7th sternite and pygidium smooth.

All femora dilated. Middle and hind tibia covered with fairly long cilia. On the middle tibia the cilia cover the distal half of the internal surface and the distal two thirds of the external surface.

In the male the elytra are 2½ times as long as the pronotum, strongly dilated backward and with short, rounded, outer corners and narrowly rounded sutural corners, the anterior three quarters of the lateral margin impressed. Elytra do not cover the last abdominal tergite but considerably overlap the abdomen behind and on

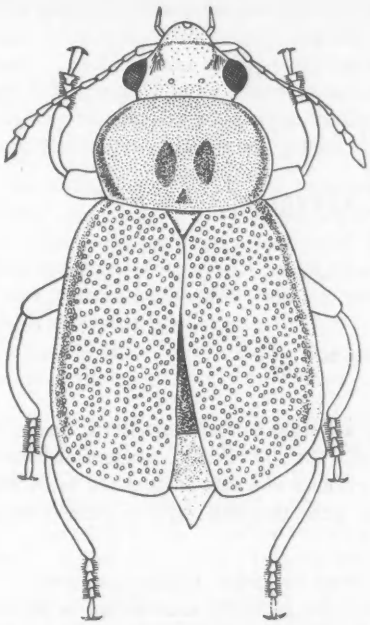

Fig. 1. Eusphalerum (Abinothum) bergi Kirschenblatt, sp. n. Male.

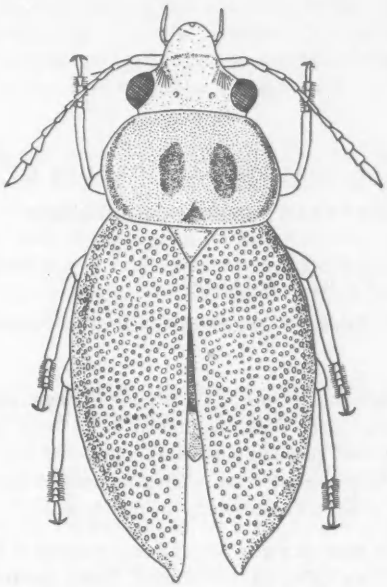

Fig. 2. Eusphalerum (Abinothum) bergi Kirschenblatt, sp. n. Female.

each side. The elytra are separated at the suture beginning at the middle of their length and forming a long, acute-angled opening through which an expanse of folded wings can be seen. The anterior tibia are curved and strongly expanded at the tip, the middle tibia are also strongly curved but the hind ones only weakly. Anterior tarsus strongly dilated.

In the female the elytra are far longer than the abdomen, elongated, oval-shaped, moderately expanded in the anterior two thirds but gradually contracting in the posterior third, with a small emargination in front of sutural angles which point backward in the form of short, rounded projections. The elytra touch at the suture only in the anterior quarter, posteriorly they separate forming a long, narrow, acute-angled slit through which the folded wings can be seen. All the tibia are straight.

Length. 2-2.3 mm.

Occurence. Georgia: Banis-Khevi gorge of the Borzhomi district, 23 VII 1909 (L. C. Berg), 1 male, 1 female (types); Bakuriani Borzhomi district, 27 VII 1947 (A. V. Bogachev), 4 males.

Types in the collection of the Zoological Institute of the Academy of Science, USSR.

Closely allied to Eusphalerum (Abinothum) kraatzi Jacq. Duv., in which the longitudinal wrinkles between the inner edges of the eyes and the ocelli are also fan-shaped. Differs from all other species of this genus by the extermely dense punctuations of the pronotum and by many other characters.

Named after the late academician L'va Semenovich Berg.

ON THE SUPERGENERIC GROUPS OF THE TRIBE HYPERINI (COLEOPTERA, CURCULIONIDAE)

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Modern systems of classifications ought to reflect the true affinities between organisms, that is, their phylogeny. Such work, inevitably, is not based upon more or less arbitrarily chosen characters of individual animals but upon complex data, considered from many angles, checked one with another and based upon facts which help to clarify the leading features of the evolution of the group members. It is to these demands that we try to adhere in this study of the Hyperini.

In spite of the rather different systems of classification adopted by various authors (Capiomont, 1867-1868; Petri, 1901; Csiki, 1934; Hoffman, 1954), the systematics of the Hyperini can be summed up, as the following: The central position is occupied by two large groups – Hypera Germ. and Phytonomus Schönh. (or, correspondingly, Donus Jek. and Hypera Germ.). The species of the first genus are characterized by the absence of wings and by a corresponding structure of thorax and elytra. In the second genus the insects are winged as usual and the exterior structure is in keeping with this fact. The second genus consists of a few subgenera but the division within the first genus has not been settled. In addition to these genera the following are well known: Metadonus Cap., Macrotarrhus Bed., Alexiola Suv. (see Zaslavskii, 1958), Bubalocephalus Cap., Limobius Schönh., Coniatus Germ. Coniatricnus Rttr. The relationship between all these groups has not been discussed by any of the authors. Although there are a number of details still awaiting interpretation we shall try to set out in general outline the new classification of the Hyperini.

In the first attempt to compare the characters which have previously been considered as fundamental, such as the presence and absence of wings, the shape of the scales and a mass of other characters, it was seen that they were completely unsuitable for classifying the large group. In the course of our work we established that the reduction of wings, and the structure of the thorax and elytra connected with it, had quite independently developed in various groups. The ignoring of the convergent character of thse features and their use as guiding principles led to clumsy mistakes. The group of species related to Hypera punctata F. serves as a good example, of this. This species, having wings, was ascribed to the genus Phytonomus, but the apterous H. fallax Cap., H. reichei Cap., H. audax Fst. were included in the genus Hypera. Nevertheless, it was shown that the latter three species were directly related to the former species and with it formed a close group. They all differed by characteristic projections on the mandibles which had almost straight cutting edges as in the genus Alexiola (Zaslavskii, 1958), by a sharply assymmetrical plate with the straight half strongly drawn out, and also by the form of the proboscis, the presence of spurs on the hind tibia of the male, the color, the shapes of the scales and by other features. Apart from the presence or absence of wings they differ among themselves only by the usual small, specific characters. The genitalia of H. fallax are almost identical with those of H. punctata (the genitalia of other species were not examined). In this way, the absence of wings with the concomitant contraction of the metathorax and disappearance of humeral protuberances are unessential characteristics in the Hyperini. This example shows that the present conception of the genera Hypera and Phytonomus has been wrongly formed.

It is widely acknowledged that in present-day research in systematics one should bring together all the accessible information on the groups being studied. It is desirable to emphasize here that in the classification of the tribe Hyperini biological observations have proved very helpful. For instance, observations on the development of the various species, as yet very superficial and in many cases quite inadequate, show the existence of various

types of life histories with real importance for classification. The study of food ties was shown to be very important, strictly characterizing individual genera and subgenera (information on food ties is not brought forward in the present article because we are outlining only the subgeneric grouping within the tribe). Information on the biology and ecology in other directions is, however, used. All this information is instrumental in determining to what extent other characters are useful for the classification and how, in the course of the work it helps in determining the position of this or that group.

The following characters were of the utmost importance in the revision of the Hyperini. In the imago the structure of the genitalia and posterior segments of the male are very useful and also, of course, various features of the external anatomy, among them, those employed earlier. The larvae possess very important characters (chaetotaxy of the labrum and epipharynx, markings, color of Malpighian tubules) which are, occasionally, of distinct value in classification in those instances where one is unsuccessful in finding characters in the imago. Finally, the larger groups are very well defined by such biological and ecological features as peculiarities in the life history, food ties, pupation, and behavior of the larvae. Taking into account all these features we divided the tribe Hyperini into the following groups.

I. Main group comprising the genera Hypera Germ. * Bubalocephalus Cap., Metadonus Cap., Macrotarrhus Bed., Alexiola Suv. They are characterized by the separated sclerites of the 8th sternite of the male, larva with pronotal tergite usually bearing only 4 bristles. Life history: oviposition in autumn, diapausing larvae or diapausing eggs, development ends in spring, imaginal diapause in summer; only one exception known up to now – Hypera crinita Boh. (Baccetti, 1958). Pupation takes place on or in the ground. The larva rests in a coiled-up position. All the species with known biology are oligophagous. A few species are winged but the majority are apterous.

II. Genus Glanis Jek.** – specific mountain group occurring in European and Asian mountains. Main characteristics are: apterous imago (a feature of mountainous conditions); sclerites of 8th sternite of male separate; larva without pronotal tergite, postdorsal bristles 3 and 5 stand clearly. Life history eggs diapause, development, under some conditions at any rate, biennial; pupation on plants; at rest the larva is extended; true polyphagy is observed in the genus (in all probability also a result of development under mountainous conditions).

III. Group including the genera Phytonomus Schönh.*** and Limobius Schönh. (second genus is more accurately considered as a subgenus of the first). This group differs in the following: imago in the majority of the species winged; sclerites of the 8th sternite of male united in front like a fork. Larvae of various forms. Development from spring oviposition, imago hibernates (exception – only Ph. elongatus Payk.); larvae pupate on plants; at rest the larva is extended; oligophagous.

IV. Group – Coniatus Germ. and Coniatrichus Rttr. Sharply separated from the other groups by the pattern and metallic color the of scales in the imago, by the sclerites of the 8th sternite of the male being fused along their whole length and forming in the middle a long appendage, and by larvae features and an association with Tamarix.

The genera Phytonomus and Hypera, as accepted by previous authors, appeared to be artificial. Thus, the inclusion in group I of the genus Metadonus Bed. and a number of species of Hypera Germ. (which made up the subgenus Antidonus Bed.) were erroneously included in the genus Phytonomus (Group II), but the species allied to palumbaria Germ., oxalidis Hbst., comata Boh., salviae Schrank., tessellata Hbst., elegans Boh. (Europe), circassicola Rttr. (Caucasus), suvorovi Fleisch., przevalskyi Suv., solida Rttr. (Central Asia), should be transferred out of Hypera auct. into the genus Glanis Jek. In our opinion the species allied to punctata F., fasciculata Hbst., scapularis Gebl., audax Fst., crinita Boh., circumvaga Boh., reitteri Fst., marmottani Cap. and others go into the genus Hypera. The position of the group Pachypera Cap. is not yet clear. According to our ideas the representative of the genus Phytonomus is philanthus Ol., which was earlier included in the genus Hypera; this species has the corresponding structure of the 8th sternite of the male (cf. Hoffman, 1954).

Systematic relationships outside the groups and species given in the communication are not considered.

*Genus type (Curculio punctatus F.) recorded by Curtis (1826).
**Genus type – Phytonomus velutinus Boh. (Jekel, 1864).
***Genus type – Curculio arator L. (polygoni L.) (Schönherr, 1826).

SUMMARY

It is shown in this article that the classifications of the tribe Hyperini suggested by previous authors (Capiomont, Petri, Csiki, Hoffmann) are unnatural. They are based on such characters as the presence or absence of wings, the shape of scales, etc. , but these features cannot characterize the major natural units of this tribe, because they have developed convergently in different groups.

On the basis of the complex of morphological characters of the adult and the larva, as well as some of ecological and peculiarities, the Hyperini tribe is considered to be divided into four supergeneric groups.

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A CADDIS FLY RHYACOPHILA SUBOVATA MART. (TRICHOPTERA, RHYACOPHILIDAE) FROM THE CAUCASUS

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A. V. Martynov studied the Caucasian caddis flies for more than 30 years beginning in 1907 (at the time of his first trip to the Caucasus) up to 1937 (the completion date of his article on the caddis flies of Nakichevan). Arranging comparatively small expeditions or collections of material pertaining to numerous and varied localities in the Caucasus, A. V. Martynov was well qualified to deal with the species composition of the caddis fly fauna of the Caucasus, thinking that he knew about four fifths of all the species of this insect living there. A. V. Martynov did not make proper use of this information on the extent of the distribution of the majority of the forms he established in the Caucasus, as he often based his conclusions on isolated observations. Because of this he reckoned that the rheophilic species – poor flyers and tied to the natural habitat of their larvae – could not be generally widely distributed even within the limits of one and the same mountainous country.

To a number of Caucasian species known to A. V. Martynov from solitary specimens many species of Rhyacophila are related, among them being Rhyacophila subovata Mart., known by the author from localities on the Voenno-Gruzinska road (Martynov, 1913: 5-7 according to his own collection; 1926: 24, according to the collection of D. A. Tarogradskii; 1934: 45). In the 1926 work the larva of Rh. subovata was briefly described and the pupal shelter was mentioned: "I think that the larva and pupa in question are related to the species Rh. subovata" (Martynov, 1926: 24). A. V. Martynov's accuracy of determination is unable to be checked because neither a specimen from which the larva of Rh. subovata was determined ("9th verst, 30 III 25, 2 larvae; Gvile , a stream on the way to Devdorakska glacier, 1 VII 1925") nor one with a description of the pupal shelter ("5 versts from Vladikavkaz, 4 VI 1925, 3 specimens") has been preserved. But in the collections at the Zoological Institute, there are specimens of the larva Rhyacophila determined by A. V. Martynov as Rh. subovata with such labels as: "16 km along VGD from Vladikavkaz, 24 V 1925, Tarnogradskii's collections". In this sample, two adult larvae are included, one of which, by the color, and shape of the head and pronotum, was able to be identified as the larva of Rh. subovata; the second specimen was poorly preserved. It is, therefore, possible to assume that A. V. Martynov acutally knew the larva of Rh. subovata and described it, but only very briefly and, above all, without any reliable diagnostic features; he concluded by giving drawings of the head.

Considerably later, in 1948, 1953-1956 – at the time when the Zoological Institute* AN SSSR was conducting its researches on a series of groups of rheophilic insects in the Caucasus – the institute investigators collected quite a lot of new material among the Caucasian caddis flies and a considerable number of adult insects, pupae and larvae of Rh. subovata Mart. was included.

This collection of material confirmed the wide distribution of Rh. subovata in the Caucasus. This species inhabits (probably uninterruptedly) the Greater Caucasus range and is abundant, here and there, in the northern districts of the Lesser Caucasian range; further south Rh. subovata becomes rarer, and, in Armenia, only single individuals were found during fairly intensive investigations of the fauna of running water (Lepneva, 1957: 14).

*S. G. Lepneva (1948-1953), L. A. Zhil'tsova (1953-1957), E. A. Tetyueva (1954), A. K. Chistyakova (1948, 1953).

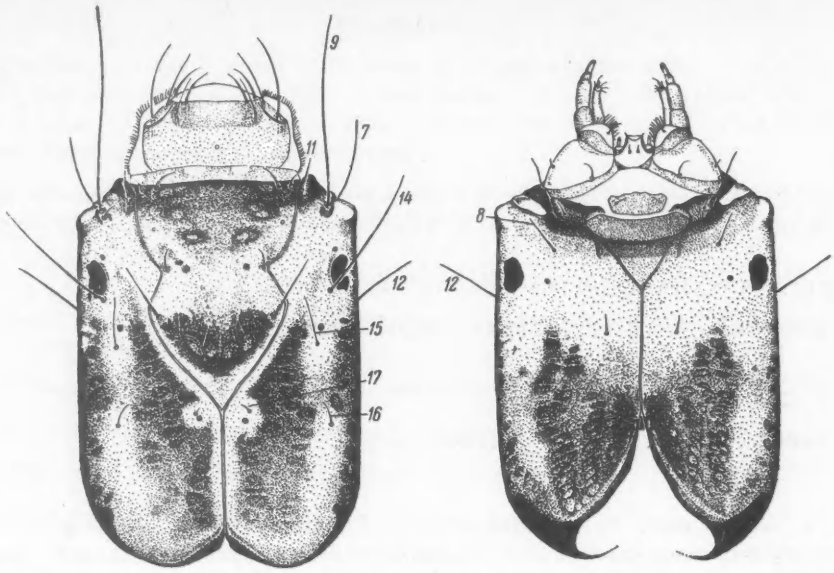

Fig. 1. Rhyacophila subovata Mart. Dorsal and ventral (on right) views of head. (Original).

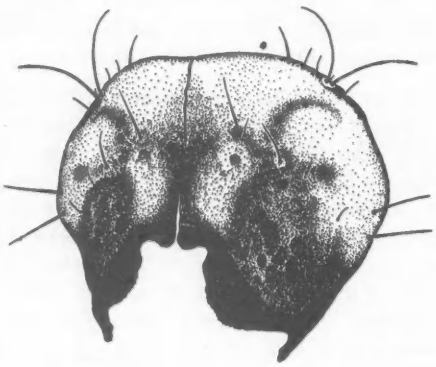

Fig. 2. Rhyacophila subovata Mart. Prothoracic tergite. (Original).

The specific characteristics of the larva of Rh. subovata described below were determined from an adult, male pupa which had the completely formed genitalia of an adult insect and permitted a reliable determination of the species; in the pupal cocoon (as in all Rhyacophilidae) a complete series of sclerites belonging to the adult insect, discarded at the time of the last pupal molt, was found; the sclerites extracted from the cocoon of a strictly determined male pupa enabled one to become acquainted in detail with peculiarities in form, color and chaetotaxy of various parts of the body of the adult larva of the species. The clear colored markings of the head and thoracic sclerites of the larva of Rh. subovata, together with a few other peculiarities, allow one easily to recognize the adult larva of Rh. subovata and, thus, the description given below was obtained. According to the colored markings the middle stage of the larva of Rh. subovata is easily recognizable in the dark, as well as in the light, varieties.

Rhyacophila subovata Mart. Larva

Adult larva. Length 18-20 mm; head (Fig. 1) comparatively wide end of characteristic shape, viewed from above nearly four-cornered, with almost parallel lateral edges, with eyes protruding slightly sideways. Ground color of head clear yellow as in the other sclerites of the body. Anterior part of frontoclypeus slightly darkened with three pairs of large spots; tentorial depression brownish, on the posterior part of the frontoclypeus is a large, blackish brown blotch, in dark specimens – of triangular shape with straight anterior edge, in light specimens – bean-like, slightly concave in front, rounded behind; on the blotch is a transverse row of four or five marks arranged in the shape of a bow, the two outer larger than the rest. Dorsal stripes straight, smoky brown, contracted in front, expanded behind and with numerous, large, blackish brown spots throughout their length; the part near the fork of the epicranial suture with bristle 17 remains light colored, the depression behind the

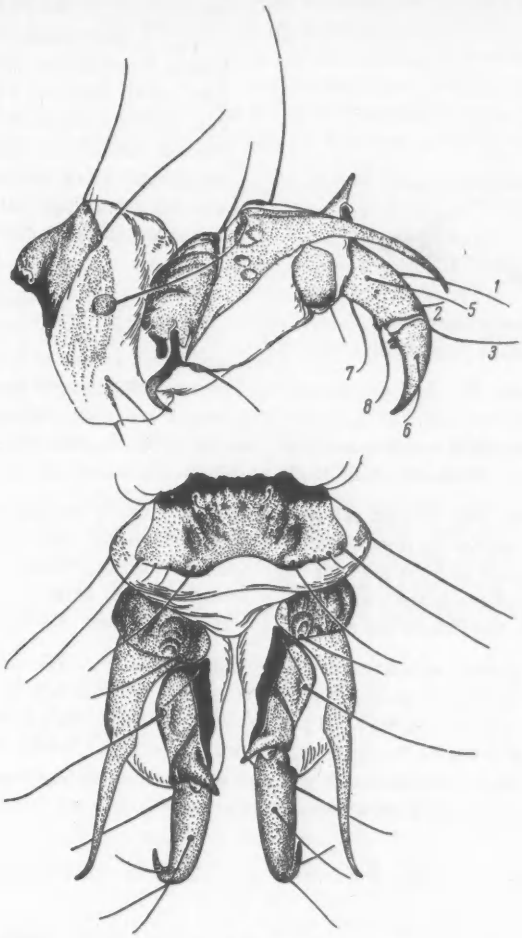

Fig. 3. Rhyacophila subovata Mart. IX segment of abdomen and anal prolegs viewed from the side (above) and dorsally (below). (Original).

bristle having a dark border. Lateral stripes unusually wide, comparatively long with longitudinal series of large, dark dots; interval between the strips light colored or with a narrow, slightly darker bridge, the short, dark setae 15 and 16 are situated on the light background, one behind the other. Ventrally, on the posterior portion along the sides around the occipital foramen, are found dark spots, fusing together and numerous dark dots.

Color variations are important; on dark varieties the area between dorsal and lateral stripes is more or less subdued; in the pale colored forms the dark background of the ventral spots becomes pale, sometimes remaining only as a group of dots; at the same time, the dorsal stripes remain unchanged or become only a little narrower.

Pronotum (Fig. 2) yellowish with the wide, hind margin and the hind portion of the lateral margin black; the extension to the edges of the hind margin wide, projecting a long way behind and with a small reddish brown portion in the middle; anterior portion of lateral margin and the part between the anterior angles outlined narrowly in brown and also the slight depression on the anterior edge. On the surface along the suture is a smoky brown line which is expanded anteriorly in the form of vague dots; along the sides posteriorly are large smoky brown spots with numerous large dots, anteriorly curved stripes with vague dots run in an arc shape to the corners, on the outside from the base is a series of large, dark dots. The two long bristles of the anterior angles

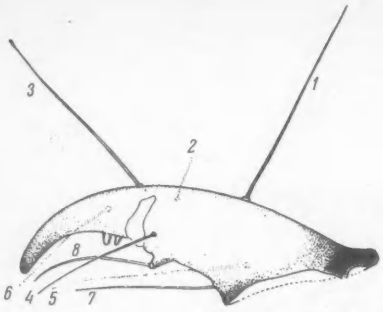

Fig. 4. Rhyacophila subovata Mart. Claw of anal prolegs from the inside. (Original).

are stout, black, the third bristles, as in all Rhyacophila s. str., microscopically small; along the edge of the medial emargination are a few fine, thin bristles and a short, stout, dark one; the medio-anal bristles and the outer bristle situated on the dark spot are shorter than those of the anterior angles, dark and stout, near their bases is one small bristle; both lateral bristles contiguous, situated not in front but somewhat beyond the anterior end of the black, lateral margin; the medial is a small chaeta.

Tracheal gills consist of a dorsal branch, curved upwards, and a group of filaments directed backwards and situated directly upon the tip of the style; on each of the I-IV segments there is one more small, ventral branch with short, delicate filaments; the filaments of the dorsal branch are generally lengthened toward the tip, a few vaguely articulated, sometimes bifurcated; number of filaments: I 23, II 24, III 23, IV 18, V 17, VI 17, VII 15, VIII 11.*

Tergite of IX segment (Fig. 3) light yellow with oblique, vaguely outlined brownish spots on each half or with medial, dark spot, narrowing toward the hind margin; border of anterior margin along the sides wide and black, medially narrowed and hind margin with large dots in the middle; black streaks of hind margin narrow; medio-anal bristles long and black and also the anterior angle bristles which are out of line; intermediate and lateral bristles small, thin, the first on the outer edge of the black streak, the second in the clear zone.

Sclerite "b" of anal prolegs with numerous large dots basodorsally, a few dots on the lateral portion; sabre-shaped extension at end slightly curved and directed backwards, the outer bristle of the distal part of the sclerite long, black, a much shorter bristle on the basal portion stout and black, the second distal, as usual in the species Rhyacophila s. str. is medial and on the edge, short, thin. Claw (Fig. 4) with rather stubby, distal portion and with one or two small, blunt, ventral spines; tubercle of basal part, at the base of bristle 8, stout; bristles 1, 3, 5 long, black; bristles 6 and 4 short and thin, brown; bristle 2 small, thin; bristles 7 and 8 light, characteristically curved.

Before pupation the larva constructs a roughly made, massive pupal shelter out of comparatively large stones and coarse gravel.

Rhyacophila subovata Mart. Preeminently a high altitude species, well known at heights of 750-2300 m and living in mountain streams of various types with clean, cold water, stony bed and, here and there, a turbulent current. In the Tereka river system, in the area of the Voenno-Gruzinsk road, the following streams, well-known habitats of Rh. subovata, are referred to: the rivers Gviletka and Kistinka, Gviletsk rivulet, river Belaya, tributaries of the Armkhi, the Lars rivulet and the Fekhtusski springs.

The Gviletka rivulet, or the Gviletis-Tskhali, flows into the Dar'yal' ski gorge, beginning high up in the mountains from springs near the snowline; in the village of Gvilety it forms a waterfall and afterwards flows as a turbulant stream among large stones washed by spray; the temperature of the water in the rivulet, according to single observations, is 8° in May, 10° in June. The temperature of the water in the other streams mentioned above is also low: in the river Kistinka it is 6° in June, in the tributaries of the river Armkhi 7.7-9.5° in May, in the river Lars 7.5° in April, 11.5° in May; springs, 9 km from Ordzhonikidze, form small fresh-water pools with a summer temperature around about 9°, giving rise at the source to a spring-fed rivulet. The temperature of the water in the river Adaikom-Don 5-8° in May, in the rivulet of the Vartseiska gorge 8°.

In the Kuban river system Rh. subovata is widely distributed in the streams of the Teberdinska State Forest and the health resort at Teberda. The principal waterway of this locality – the river Amanauz-Teberda** which has its source in the glacier of the Greater Caucasian range in the Amanauz mountains. The river is turbulent

*The number of filaments, as usual, varies within the limits ± 1-3.

**Amanauz – as far as the mouth of the river Gonachkhir, below Teberda.

and near the bank in the region of the health resort, the speed of the current is about 1.5 m/sec in summer; the river bed is stony; the temperature of the water at the source in summer (19 VI 1954) 1.0° (with an air temperature of 16°), a little lower than 4.0° (28 VII 1954); near the health resort at the end of June (30 VI 1954) in the morning 8.0°, during the day 10°; in July (30 VII 1954) at various times of the day 9.5-10.0-11.5°; in August (2 VIII 1954) 13. 5°; the last figure represents the maximum temperature recorded during the summer of 1954 from the thermometric data collected by the expedition in localities inhabited by Rh. subovata.

From the left-bank tributaries of the Teberda the river Baduk (tributary of the river Khadzhibei), in its upper reaches, flows swiftly, the temperature of the water in June (5 VI 1955) 5.0°. The temperature of the water in the estuary portion of the river Minor Khotipara, with a speed of 0.7 m/sec , at the beginning of July (4 VII 1954) amounted to 13°. At its source the river Mukhu runs at a height of about 2700 m; the speed of its current in summer drops from 1.0 m/sec in the middle of its course to 0.7 m/sec lower down; the temperature of the water in July (16-24 VII 1954) in the upper and middle courses 9-11°, in August in the upper reaches of the stream at a height of 1900 m* 11.5°, in the middle (8-11 VIII 1954) 12.5-13.5°.

The right-bank tributary of the Teberda, the river Dombai-Ul'gen, fed with snow and glacier water and flowing into the Teberda at a height of 1560 m has, here and there, a turbulent course, the temperature of the water in June (17 VI 1955) 7°, in July (6-30 VII 1954) 5-8°. The temperature of the water in a rivulet, a tributary of the river Dombai-Ul'gen, with a current velocity of about 1 m/sec is somewhat lower at the beginning of July (6 VII 1954) 8.0°, at the end (27 VII 1954) 12.0°. The river Ulu-Murudzhu, a large tributary from the right bank of the Teberda, maintains a low water temperature throughout the summer not exceeding 8.0° in August (3-23 VIII). In the small river Shumka the water temperature is rather higher, in July (13 VII 1954) 9°, in August (23 VIII 1954) 10°, in October (23 X 1954)5.5°. The large tirbutary of the right bank of the river Reberda, the river Dzhemagat, is turbulent in the center of the stream, slower at its banks, the temperature of the water in July (14 VII 1954) 9.0°.

On the southern slopes of the Greater Caucasian range in a rivulet, a tributary of the river Liakhvy, at a height of 1100 m, the temperature of the water in October (22 X 1956) 5.5°; in a tributary of the river Shaori in the neighborhood of Kutais in August (21 VIII 1954) 7.0°.

In the northern part of the Lesser Caucasus in the region of the Trialetian range Rh. subovata is abundant in the rivulet Bakurianka from the source to the mouth and it also lives in the spring-fed rivulets of this district. The Bakurianka flows at first in the springs of an alpine zone at a height of about 2470 m, discharging into the Gudzharetis-Tskhali at a height of about 1020 m; consequently, the over-all drop in the bed of the stream amounts to about 1450 m. Fluctuations in its level are considerable; at the time of the spring and summer floods and after heavy rain the water in the river is at its highest level, it becomes dingy brown in color, swelling and running impetuously, reminding one of a rushing torrent. At the time of the steady low-water level in summer the water in the stream is clear and pure; it is saturated with salts and has a pale bluish tinge and a hardness of 1.9-2.5 German degrees; hydrogen ion concentration is weakly alkaline (pH 7.2-7.4), oxygen capacity, 0.7-1.1 mg O_2 (Murvanidze, 1948: 57). Depth of stream in summer in its upper reaches 15-20 cm., in the greater part of its course 25-50 cm, in the lower reaches where it discharges into the Gudzharetis-Tskhali 50-60 cm. The bed is stony from alluvial boulders, and pebbles; the speed of the current in the upper reaches and in the middle part of the river in summer fluctuates from 0.5-0.9 m/sec , falling in the lower reaches to 0.3-0.5 m/sec. The temperature of the water in the Bakuriani district in July (9-14 VII 1953) 9.0-16.0°, on an extra sunny day 18° (14 VII 1953) in August (24-25 VIII 1954) 17.5-14.5°.

In the upper reaches of the Bakurianka in a small stream, a tributary of this river, 3 VIII 1953, the temperature of the water at midday reached 17.0° – a very high summer temperature for the habitat of Rh. subovata in the alpine zone.

In the springs of Tskhra-Tskharo pass the temperature of the water in August (28 VIII 1953) was 6.0-7.0°. In Armenia, in the river of the Semenovskii pass** the temperature of the water in June (19 VI 1956) was 12.0°.

The over-all, annual range of temperature under conditions in which the larvae of Rh. subovata are known to live, varies in the different Caucasian districts from 0° (winter minimum) to 18° (summer maximum).

*The extreme northwestern point inhabited by Rh. subovata (18 VIII 1954) 22 larvae length 9-19 mm, Tetyueva).
**The extreme southern point inhabited by Rh. subovata (height 2050 m, 9 VI 1956, 1 specimen, Zhil'tsova).

Rh. subovata is preeminently an early spring species hibernating in the larval instar from which the majority emerge near the end of their development; the prepupae of Rh. subovata are already met with in February (2 II 1939). In May and June, as well as in the first half of July, adult larvae, prepupae and pupae are constantly found in the underwater populations of Rh. subovata; at the same time of the year, beginning with 30 VI, the adult males and females of Rh. subovata are always seen on the shores, usually in the second half of July. Those males and females flying in August probably belong to a new generation developed from eggs laid in April and May; solitary specimens of the imago of Rh. subovata were met with in the Bakuriani districts 23 October (1953). Among the underwater populations in August the larval stages destined for hibernation predominate, having originated from eggs laid in spring and early summer; among the populations already hibernating at the end of August (24-28 VIII) adult larvae and prepupae are present; a number of the latter give rise to late adults, the majority overwintering together with larvae.

SUMMARY

Rhyacophila subovata Mart. – Larva.

Head with parallel lateral sides (Fig. 1). The anterior part of frontocylpeus with three pairs of large dots; on the posterior part there is a dark spot with a transverse row of five pale dots of which both extreme ones are the largest. Dorsal bands wide with numerous large dark dots; lateral bands with distinc. dark dots; the interval between the lateral and dorsal bands usually light, sometimes slightly darkened; near the posterior margin ventrally there are large dark spots with numerous large dots, which is a specific diagnostic character of this species (Fig. 1).

Pronotum (Fig. 2) yellow with large brown spots; posterior margin black without brown intervals; lateral margin with broad black band behind and narrow brown band in front.

Tracheal gills with an elongated dorsal branch the filaments of which especially distal, in some specimens indistinctly articulate, sometimes bifurcate.

Anal prolegs with a characteristic large sabre-shaped projection (Fig. 3). Claw with a blunt ventral spine; tubercle at the base of seta 8 large.

The larva of Rhyacophila subovata has been briefly described (without illustrations) by Martynov (1926: 24).

Rhyacophila subovata is widely distributed in the rgeion of the Main Range of the Caucasus mountains; it is also known from the Bakurianka rivulet (the Trialetian Range, Transcaucasia). Further south, in Armenia it becomes extremely rare (occasional findings in the region of the Semenovskii pass, to the north of the Lake Sevan).

The larvae live in brooks, rivulets and also in larger streams (e.g., the Teberda river) with pure cold (summer temperature in June, July and August 4-13° C, rarely attaining 16-18°C) rapidly flowing (1.0-1.4 m/sec) water. In the sites of occurrence of the larvae the bottom is composed of large or small stones or pebbles. The larvae live on the lower surface of stones. Rh. subovata hibernates as middle- or late-instar larvae.

A large proportion of the latter, by the end of the winter (February) develop into prepupae, beginning to build the pupal cases. The adults fly throughout the summer, occurring in greatest numbers during the first half of the summer, from May till the middle of July.

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GALL WASPS OF THE TRIBE AYLAXINI (HYMENOPTERA, CYNIPOIDEA) NEW FOR THE FAUNA OF THE USSR

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Species of gall wasps belonging to this tribe produce galls on various herbaceous plants of the following families: Compositae, Labiatae, Rosaceae, Papaveraceae, Gramineae, Umbelliferae, Linaceae and Valerianaceae. The list of families and species of plants on which the gall wasps of this tribe develop, will doubtlessly be greatly expanded, since both the species complex and the geographical distribution of the tribe are known only superficially. New research on these interesting insects is absolutely necessary.

As other gall wasps, the species of this tribe are narrowly specialized, each species being trophically related to a certain plant, or to another close species, usually belonging to the same genus.

Ashmid called the tribe Aulacini, but with the change of the spelling for the type genus, the tribe name should be changed to Aylaxini.

The tribe Aylaxini, together with the inquiline subfamily of Synergariinae and the tribe Pediaspidini, is distinguished from other gall wasps of the family Cynipidae by a "broad" pronotum. The length of the pronotum along the middorsal line constitutes a third or a sixth part of its length along the lower lateral border. Gall wasps which develop on oaks and rosebushes have a "narrow" pronotum, whose length along the middorsal line is only a ninth part of its length along the lower lateral border.

The inquilines are distinguished by the fused 2nd and 3rd abdominal segments, which (as well as the remaining abdominal segments), in species of the Aylaxini tribe, are clearly divided by a suture. The tribe Pediaspidini is distinguished from Aylaxini by the absence of pits or transverse furrows on the base of the scutellum. There is only one species, Pediaspis aceris (Gm.), in this tribe, developing on maples.

All the species of Aylaxini reproduce sexually. Only in species of the genus Phanacis are the males, relatively seldom found. As a rule, one bisexual generation of these gall wasps develops during the year. Speculations on the presence of several generations a year in Panacis carthami Guss. and in Panteliella fedtschenkoi Rübs. have not been substantiated by direct and thorough observations.

The material for the present study was obtained from collections kept at the Institute of Zoology, AN SSSR and from the author's own collections, which have been also given to the Institute of Zoology. Most of the species mentioned here are new for the fauna of the USSR; some new and more detailed data on the distribution of the few, previously known species, are presented.

Isocolus Foerster

Radial cell on the anterior edge of the wing open; wings without microtrichia or macrotrichia; areola distinct; 3rd segment of the antennae of females shorter than the 4th; mesonotum, scutellum and mesopleura leathery. Galls in stems and inflorescences of Centaurea L.

Isocolus areolata Giraud

All the individuals were reared from the stems and inflorescences of Centaurea maculosa Lam., collected by the author.

Kursk region: Ryshovo, Aug. 1947, 1♀; Kursk, June, 1958, 15♂♂ and 45♀♀; Sudzha, June, 1958, 9♂♂, 15♀♀.

Belgorod region: Bol'shetroitsa, June, 1939, 1♂; Belgorod, June 1931, 7♂♂, 26♀♀.

Saratov region: Saratov, June, 1958, 1 ♂, 35 ♀♀.

Isocolus scabiosa (Giraud)

The author was able to collect only two galls of this species on October 30, 1945 in the vicinity of Belgorod, on the tips of stems of Centaurea scabiosa L. One gall was 70 mm in length and the other 45 mm. In May, 1946 chalcids emerged from the galls; gall wasps could not be reared.

Isocolus rogenhoferi (Wachtl)

The individuals listed below have been reared from the stems and inflorescences of Centaurea scabiosa L., collected by the author.

Kursk region: Sudzha, May 6 to June, 1948 and 1958, 2♂♂ and 9 ♀♀; Ryl'sk, June, 1955, 6♂♂ and 5 ♀♀; Kursk, June, 1948 and 1958, 5 ♂♂ and 6♀♀.

Belgorod region: Urazovo, July, 1947, 2♂♂ and 3♀♀; Bol'shetroitsa, June, 1939, 1♂ and 1 ♀; Krasnaya Yaruga, June, 1939, 1♂ and 1 ♀.

Kalinin region: June, 1936, 1♀.

Isocolus jaceae (Schenck.)

Ryl'sk, Kursk region, 1 ♀ reared in June, 1957 from inflorescences of Centaurea scabiosa L.

Diatrophus Hartig

Radial cell open; tarsal claws dentate; length of genae not less than 0.7 of the length of eyes; frons with fan-like furrows; scutellar pits open posteriorly. Galls on Potentilla L. and Rubus L.

Diastrophus rubi (Bouché)

All the galls mentioned below were collected by the author only on dewberry; galls were not found on raspberry or on other species of Rubus. Often found in forests along river bands.

Kursk region: L'gov, Sept. 29, 1937 and April 9, 1938, in May, 1938 2♂♂ and 2 ♀♀ emerged from the galls; Sept. 21, 1946 and May 8, 1947, in May, 1947 one ♀ emerged; June 10, 1956, galls with emergent openings. Ryl'sk, April 28, 1940; Sudzha, Sept. 30, 1939; Kursk, June 20, 1954, galls with emergent openings; April 30, 1956, from these galls in May, 1956 emerged 8 ♂♂ and 22 ♀♀ D. rubi and 237 chalcids.

Graivoron, Belgorod region: Sept. 20, 1931; Maikop, Krasnodar region, Aug. 2, 1953, chalcids emerged.

Diastrophus mayri Reinh.

Galls often found on cinquefoil growing in forest fringes, along field and forest roads, on slopes of ravines; gall wasps could not be reared from them. All found by the author on Potentilla impolita Wahlenb. in the following localities.

Kursk region: Dmitriev, Sept. 14, 1947; Sudzha, Sept. 28, 1947; Oboyan', Sept. 30, 1945, Medvenka, June 30, 1955; Ponyri, July 20, 1947; L'gov, Sept. 5, 1957; Kursk, Oct. 7, 1957; Belaya, Aug. 10, 1958.

Belgorod region: Graivoron, Oct. 10, 1940; Belgorod, Oct. 30, 1945.

Xestophanes Foerster

The characteristic of this genus is the presence on the middle of the dorsal part of the pronotum of two small, but distinct pits. Also, the tarsal claws are simple; length of genae is not more than 0.5 of that of eyes; fan-like furrows of the frons ill-defined; scutellar pits closed posteriorly. Galls on Potentilla L. and Sibbaldia L.

Xestophanes potentillae (Tetz.)

Galls of this species were collected by the author on Potentilla impolita Wahlenb. Oct. 18, 1939 in the vicinity of Novyi Oskol, Belgorod region, and also on June 28 and Oct. 10, 1940 in the vicinity of Graivoron,

Belgorod region on Potentilla canescens Brss. In none of these cases was it possible to rear any gall wasps. The author received from V. Pliginskii for identification 4 ♀♀ of this species, which were reared by him from galls on Potentilla pimpinelloides L., collected in 1940 in the arboretum Galich'ya Gora, Lipetsk region.

Panteliella Kieffer

Only one species, P. fedtschenkoi Rubs., is known in this genus. Forms galls on leaves and inside hollow stems of Phlomis L.

In the Central Blackearth Belt, P. fedtschenkoi Rübs. were collected by the author from Phlomis tuberosa L. in the following localities:

Kursk region: Kabanskii Sovkhoz of Zolotukhin district, July 25, 1951, in May, 1952 3 ♀♀ emerged from the galls; Lukashevka Ivaninsk district, June 25, 1947 and June 21, 1949, in neither case did gall wasps emerge; Ryl'sk Aug. 28, 1955, in May, 1956 emerged 6 ♂♂ and 2 ♀♀; Sudzha, Sept. 28, 1947 and Aug. 20, 1951, in both cases in the month of May of the following year several dozens of gall wasps emerged; Medvenka, June 30, 1955 1 ♂ emerged from leaf galls and also some chalcids; Oboyan', Sept. 30, 1945, in May 1946 emerged more than 100 ♂♂ and ♀♀ gall wasps; Somovka Gorshechenski region, Sept 12, 1953. Galls on old dried spring leaves of sage, as well as on leaves of summer stems of the same plant. In the former case the galls had emergent openings. The presence of galls on young, newly formed leaves and the simultaneous presence of emergent openings on earlier galls, presuppose the possibility of development of a second generation of these gall wasps in certain years. This supposition, however, must be verified by direct observations. From the galls collected in May, 1954 emerged 11 ♂♂ and 11 ♀♀ gall wasps.

Belgorod region: Krasnaya Yaruga, May 10, 1947, in May of the same year emerged more than 200 ♂♂ and ♀♀ gall wasps; Graivoron, Aug. 7, 1938, during May-June also more than 200 ♂♂ and ♀♀ emerged from these galls; Bol'shetroitsa, Sept. 17, 1938, in May, 1939 emerged 3 ♂♂ and 1 ♀; Urazovo, June 30, 1947, gall wasps did not emerge; Valuiki, Oct. 15, 1939, during May-June of the following year about 70 ♂♂ and ♀♀ emerged from these galls; Borisovka, April 23, 1941, during May of the same year emerged 7 ♂♂ and 17 ♀♀.

In addition to this, there is in the collection of the Institute of Zoology AN SSSR, 1 ♂ P. fedtschenkoi Rübs. from Simferopol' (May 17, 1927, E. and V. Kuznetsov) and 1 ♀ from Mongolia (Sutszukté gorge, sw. Kentei, July 1-5, 1925, Kozlov). The Mongolian specimen resembles specimens from the Central Blackearth Belt of the USSR, but has a more convex frons.

Liposthenes Foerster

Mesonotum bare and shiny; third antennal segment in the female not shorter than the fourth. Scutellar pits closed posteriorly; areola absent.

Only one species, L. glechomae L.(= latreillei Kieff.) is known, widely distributed in the European part of the USSR and in Western Europe. This species has been introduced into North America, where it became distributed in a number of eastern states: Massachusetts, Connecticut, New York, New Jersey, Ohio, Indiana, Illinois. Galls found on Glechoma.

Liposthenes glechomae Linné

"Count's Pavillion" - vicinity of Leningrad, April 26, 1898, 1 ♀, Mazarakii; Berditsino, Yaroslav region, June 14, 1890, 1♀, A. Yakovlev; Yaroslavl', Sept. 6, 1890, 2 ♀♀, N. Kokuev; Kostroma, 1927, 1 ♀, V. Gussakovskii; Odessa, July 27, 1924, 3 ♀♀, Yu. Zimin.

Kursk region: Ryl'sk, Sept. 8, 1937 and June 14, 1955 on G. hirsuta W. et K. in groves on heights of the right bank of the river Seima; 1 ♂ emerged from the galls; Kornevo, Aug. 5, 1955, on G. hederacea L., gall wasps did not emerge; L'gov, Sept. 29, 1937, during April of the following year 1 ♀ emerged; Lukashevka, June 21, 1949 on G. hederacea L., immature galls, gall wasps did not emerge; Makarovka, Ivaninsk district, June 13, 1948, immature galls; Sudzha, Sept. 17, 1937 and Sept. 28, 1947, oak-alder forest in the valley of the river Psel on G. hederacea L.; Kursk, 18 June, 1937, and April 24, 1938, on G. hederacea L., during April 1938 1 ♂ and 6 ♀♀ emerged. In 1955 in the oak-alder forest, along the low right bank of the river Seima ("Solyanka" arboretum), the author found a large number of gall wasps, and subsequently of galls of L. glechomae L. The emergence of the gall wasps

took place during the month of April and during the first half of May. On the 3rd. of June the galls reached their normal size, but the larvae were in the second stage. When the galls were opened on the 19th of June, third-stage larvae were found within, filling up completely the entire larval chamber; the galls gradually become darker on the outside, but internally they still consist of a juicy, white, spongy mass. At the beginning of their development, the galls are light green on the outside, the same color as the leaves or stems of the ground-ivy, later their sides become purple or reddish brown. On the 3rd of July the internal part of the galls became dry and the tissue was found divided into strands, radially divergent from the larval chambers toward the periphery of the galls; the walls of the larval chambers were rough and dark. Development of the larvae continued till the end of August. 156 completely mature galls were collected on Sept. 24, for the purpose of rearing of gall wasps. The outer integument of the galls was thin, grey, light brown or brown in color. The entire galls were filled with dry, very fine, radially disposed fibers, white or grey in color. Mostly, already-winged gall wasps were found in the oval, hard-walled larval chambers, in the centers of the galls. These gall wasps emerge only in the spring of the following year. The galls developed on the leaves as often as on the stems. Of the total number of galls 56 % were single and 44% were multicameral, with 2-4 chambers. Size of single galls: length 8-15 mm, average 12 mm, width 7-14 mm, average 10.6 mm; multicameral galls were 16-30 mm, average 23.2 mm in length , and 12-24 average 17.2 mm in width. The larval chambers were 3.5 mm in length and 2.0 mm in width; in the single galls the chambers are in the center; multicameral galls consist of 2, 3 or less frequently 4 fused, single galls, in the center of each of which is the larval chamber. From these galls in April 1956 emerged altogether 17 gall wasps and 54 chalcids. Oboyan', Nov. 20, 1955, on Glechoma hederacea L., from these in April, 1956 emerged 1 ♀ and some chalcids.

The following localities in the USSSR are known to have this species: Moscow region (Rübsaamen, 1895), Tula region (Trusova, 1915), Voronezh region (Vaniny, 1927), Saratov region (Silant'ev, 1894), Crimea (Rübsaamen, 1895), western Kazakhstan (Vyrzhikovskaya, 1954).

Vetustia V. Belizin, gen. nov.

Head broader than thorax, covered with short hairs; frons furrowed fan-like. Antennae of female consisting of 13 segments; 2nd segment almost spherical; 3rd segment short and slender, half as long as the 4th. Propleura covered with dense hairs which lie flat, thus obscuring the relief of the propleura; mesopleura furrowed. Mesonotum dull, almost bare; parapsids distinct almost to the anterior border of the mesonotum. Scutellum covered with sparse hairs, with two oblique pits, not closed posteriorly, at its base. Wings transparent with dense trichia; radial cell open at its anterior border; areola large, closed. Abodmen smooth, shiny.

Type species: V. investigata V. Belizin, sp. nov.

Galls on Phlomis tuberosa L.

Vetustia investigata V. Belizin, sp.nov.

Female. Completely black, except for the flagellum of the antenna, which is brown; upper half of femur, tibia and tarsus yellowish red. Head and thorax leathery, dull; abdomen smooth, shiny. Head broader than the thorax, covered with dense, short hairs; clypeus bare, smooth and shiny; frons with fan-like furrows; maxilae brown-red with black teeth. An elevated bare line stretches from the base of the antennae almost as far as the clypeus. Antennae 13-segmented; first three segments black, the rest brown; flagellum thick, almost spindle-shaped; length of antennae only a little greater than that of head and thorax together. Second antennal segment almost spherical; 3rd segment bead-like, it is the thinnest and the shortest, half as long as the 4th; 4th-8th segments are the longest, equal to each other in length; the remaining segments shorter; the last segment is sharp at its tip and longer than the one before it. The tip of each segment, starting from the 4th is longitudinally striated; the flagellar segments are covered with very fine hairs.

Propleura covered with dense, yellowish grey hairs, which lie flat; posterior border of the propleura with sparse carinate ridges. Mesopleura bare, shiny, covered by dense thin furrows. Metapleura hairy. Mesonotum dull, leathery, faintly shiny. Parapsids deep, distinct almost throughout their entire length; between them, in the anterior part of the mesonotum, there are two parallel, widely separated furrows; external lateral furrows of the mesonotum are broad, with smooth bottoms; they almost reach the anterior edge of the mesonotum. Scutellum rounded, hemispherically convex, with two shiny, obliquely disposed pits at its base, not closed posteriorly; the bottom of the pits is longitudinally striated. Scutellar discus wrinkled, with sparse flat hairs. Intermediate segment with dense intertwining flat hairs.

Wings transparent with very dense short trichia; anterior edge of wings is bare; the apical border with dense short hairs. Wing veins dark brown. Radial cell open along the anterior edge of the wing, 2½ as long, as it is broad; all the veins making up the radial cell are curved. Areola large, closed. Cubital and anal veins distinct to the wing's edge. Legs with short light colored hairs. Coxae, trochanters and the broad half of the femora almost black; the remaining parts of the legs yellowish red.

Abdomen smooth, shiny; 2nd abdominal segment constitutes almost half the entire abdomen; 1st tergite with long light colored hairs; hypopygium smoky colored, broad. Length of the body 2-2.3 mm.

Holotype and paratypes, numbering in all 6 ♀♀ reared in January 1957 from galls on Phlomis tuberosa L., collected by the author in September 1956 in Lukashevka, Ivaninsk region, Kursk district. All the specimens are kept in the collection of the Zoological Institute of the Academy of Sciences of the USSR in Leningrad.

The genus Vetustia, gen. nov., is distinguished from its related genera by the following characteristics:

From Liposthenes Foerst. – by a very short 3rd antennal segment in the female, by the presence of an areola on the wings, by scutellar pits not closed posteriorly, by a dull mesonotum;

From Aylax Hart. – by the furrowed mesopleura, by the short 3rd antennal segment in the female, by the dense hairiness of the propleura, by lesser hairiness of the wings;

From Isocolus Foerst. – by dense trichiation of the entire surface of the wings and by the entirely densely hirsute propleura.

Galls develop on inflorescences of Phlomis tuberosa L. and stand out like the sclerotia of ergot in ears of rye. They are elongate-rounded or almost spherical, sometimes cone-shaped. Usually the galls are sessile, sometimes with a short stem. Size of galls: length 7.5-10 mm, width 5.5-8.5 mm. Galls are very hard, woody, with a small and narrow larval chamber, whose length is 4 mm and width is 1.5-2 mm; the walls of the chamber are uneven, not smooth. Surface of galls dark grey or greyish brown, with several not very distinct longitudinal ridges. Interior of the galls consists of very dense, woody, light grey tissue, granular in structure.

Earlier, the author collected galls of this species also from Phlomis tuberosa L. in the state reservation Streletskaya Step', Kursk region, on July 25, 1951; in Kazanskii Sovkhoz, Zolotukhinsk district, Kursk, region, on Aug. 25, 1951; in the vicinity of Urazovo, Belgorod region, on Oct. 15, 1951. Gall wasps could not be reared in any of these cases.

Aylax Hartig

Radial cell open; 3rd segment of antennae of the female equal to or longer than the 4th; mesopleura usually leathery; areola distinct. Galls on various herbaceous plants of the families Compositae, Labiatae and Papaveraceae.

Aylax taneritis, V. Belizin, sp. nov.

Female. Entirely shiny, of one color, reddish brown; only antennae and legs lighter in color, yellow.

Head leathery, delicately stippled. Frons with fan-like, fine and delicate furrows, extending from the clypeus to the eyes. A sharp keeled elevation between antennal pits. Eye orbits smooth and shiny. Eyes elongate-oval; ocelli small, light colored. Antennae 12-segmented, reaching the apex of the scutellum in length. Antennal segments straight, almost cylindrical; 1st segment somewhat shorter than the 2nd; the following segments almost all equal in length, except the ultimate segment which is almost twice as long as the penultimate.

Pronotum "wide", almost dull in color, entirely covered with dense, delicate dots. Mesonotum shiny, delicately leathery. Parapsids narrow, but deep, distinct throughout their entire length. Two shallow but distinct parallel furrows in the anterior third of the mesonotum, between the parapsids. A deeper lateral furrow, one on either side in the posterior half of the mesonotum, externally to the parapsids. Mesopleura convex, shiny, with fine and dense longitudinal furrows. Scutellum at a lower level than the mesonotum; its discus is rougher in texture than the mesonotum; at its base there are two small, shallow obliquely disposed, smooth and shiny pits. Metapleura very narrow, leathery. Tarsi of the anterior pair of legs more than 1½ times as long as the tibiae; posterior tarsi as long as the tibiae. Tarsal claws very small. Wings transparent, almost bare; veins pale, inconspicuous. Radial cell open, narrow and long, 3 times as long as it is broad. Areola indistinct.

Abdomen shiny, smooth. Length of body 2.6 mm.

Holotype: 1 ♀, Takhta-Karacha, south of Samarkand, Uzbek SSR, 1500 meters above sea level, June 13, 1932 (V. Gussakovskii). Kept in the collection of the Institute of Zoology, AN SSSR in Leningrad.

It is related to A. ibericus Tav., but is distinguished from this species by a leathery and not a wrinkled mesonotum; by a single-colored, reddish brown coloration; by 12-segmented antennae and by a longer radial cell.

Aylax kerneri (Wachtl)

Galls of this species were collected by the author on July 27, 1951 in the state reservation Streletskaya Step' near Kursk, on Nepeta nuda L., and on Aug. 27, 1955 in Ryl'sk, Kursk region, also on Napeta nuda L. In both cases large numbers of mature galls were found, but gall wasps could not be reared from them. In the month of August the galls were mature and dropped to the ground when the plants were touched even very lightly.

Aylax salviae (Giraud)

Kursk region: Sudzha, Sept. 28, 1947, galls on Salvia pratensis L., gall wasps did not emerge; Somovka, Gorshechenskii district, Sept. 12, 1954, on S. pratensis L., chalcids emerged from the galls in the month of May of the following year.

Belgorod region: Urazovo, June 30, 1947, on S. nutans L., and on S. nemorosa L., in May, 1948 emerged 5 ♂ and 9 ♀♀ from the galls; Graivoron, Aug. 7, 1938, on S. pratensis L., 1 female and 4 males were reared in the month of May of the following year; Krasnaya Yaruga, July 10, 1939, galls on S. pratensis L., chalcids emerged from the galls in May, 1940.

Also: Yalta, Crimean region, Nikitinka Botanical Garden, in 1945 2 males and 2 females were reared from galls collected from S. sclarea L.; Lebyazh'e, Altai region, in 1949 emerged 1♂ and 6 ♀♀ of A. salviae Gir. from galls collected on Aug. 4, 1948 from Salvia nemorosa L., (M. Nikol'skaya).

Aulacidea Ashmead

Radial cell closed along the anterior border; third antennal segment in the female not longer, or slightly longer than the 4th; scutellar pits large and distinctly divided; mesopleura furrowed. Galls on Compositae, Labiatae and Gramineae.

Aulacidea phlomica V. Belizin, sp. nov.

Females and males. In the females the entire head, antennae and legs of a single color, muddy yellow; all pleura and abdomen, except the dorsal parts of the 2nd and 3rd tergites, reddish brown; sometimes all these parts of the same muddy yellow color as the head, antennae and legs; sternites of thorax, and sometimes pronotum, metapleura and intermediate segment, brown; eyes, pronotum, except the upper edge, mesonotum, scutellum and the upper parts of the 2nd and 3rd abdominal tergites, except their posterior edges, black; sometimes a black spot or line under each eye. Males of the same coloration, but the upper parts of the 2nd and 3rd tergites are entirely black.

Clypeus small, well defined, sometimes hemispherically convex, sometimes covered with dense, long white hairs; from it numerous, thin, sharp furrows diverge in a fan-like manner along the genae and frons; genae and frons covered with very short, thin, light colored flat hairs; posterior borders of the temples with dense, erect short white hairs. Antennae of the females 12-segmented, reaching only to the middle of the abdomen with their apex; 1st segment curved, broader at the apex; 2nd segment thick, almost half as long as the 1st ; 3rd segment a little shorter than the 4th, the two almost cylindrical; 5th to 7th segments identical, a little longer than the 4th; 8th to 11th segments shorter than the preceding ones; last segment the longest, twice as long as the penultimate. Antennae of the males 14-segmented, almost equal in length to the length of the body; 3rd segment very slightly curved, obviously shorter than the 4th; the remaining segments gradually become shorter, except the last one, which is twice as long as the penultimate.

Propleura covered with dense flat hairs, which obscure the relief; mesopleura flat, shiny, densely and delicately furrowed; metapleura dull, very small, narrow sclerites; intermediate segment covered with dense hairs on either side; among these immediately under the metanotum there is a well-defined elevation, in the shape of a blunt horn or a bump.

Mesonotum leathery, dull, sometimes a little shiny; parapsids distinct only in the posterior half of the mesonotum, sometimes they do not reach the anterior border; two distinct parallel furrows in the anterior third of the mesonotum; also distinct, between parapsids and lateral edges of the mesonotum, there are posterior lateral furrows, which reach to the middle of the mesonotum; surface of the mesonotum almost flat, covered with very thin, inconspicuous hairs. Scutellum almost round, dull, slightly convex, roughly wrinkled; sometimes it is almost smooth at the base; pits flat, well defined, obliquely disposed.

Wings transparent, covered with dense, but very delicate microscopical setae; anterior border bare. Veins ligh colored, yellow. Radial cell closed along the anterior border, broad and long, almost 3 times as long as it is broad; second part of the radial vein almost straight, only a little curved at its apex; it is almost 3 times as long as the first part of this vein, which is curved into the radial cell. Areola consists of thin translucent veins, but is distinct. Cubital and anal veins distinct.

Legs of a single color, yellow, with short, dense hairs; posterior part of the last coxae smooth, bare, shiny; there is a row of dense, longer hairs along the edge of this bare surface.

Abdomen bare, shiny, smooth; only the anterior lateral edges of the 2nd tergite are covered with dense, light colored hairs; hypopygium short.

Length of the body: ♂ 1.0-1.2 mm, ♀ 1.2-1.4 mm.

Galls are found frequently and in large numbers. They develop upon the inner surface of the hollow stems of Phlomis tuberosa L.; the galls are single, thin-walled elongate, 2 mm in length, white in color.

This species resembles A. rugiscuta Thoms. in its coloration, but it is well distinguished from it by the 12-segmented antennae of the females and the 14-segmented antennae of the males, by the structure of the antennal segments, and by the presence of outgrowths on the sides of the intermediate segment.

All the specimens of this species mentioned below are kept in the collection of the Institute of Zoology, AN SSSR in Leningrad.

Types and paratypes, (in all, more than 200 females and males) were reared from galls collected by the author in the following localities of the Kursk and Belgorod regions:

Kursk region: Sudzha April 30, 1939, during May-June, 1940 emerged 42 ♂♂ and 31 ♀♀, same place, Sept. 28, 1947, during June 1948 emerged 7 ♂♂ and 15 ♀♀, same place, Aug. 20, 1951, gall-wasps did not emerge from these galls; Oboyan', Sept. 30, 1945, during May-June, 1946 emerged 9 ♂♂ and 22 ♀♀; Kazanskii Sovkhoz, Zolotukhinsk district, July , 25, 1951, galls immature, during May, 1952 emerged only 3 ♀♀; Somovka, Gorshechensk district, Sept. 12, 1954, during May, 1955 emerged only 1 ♂.

Belgorod region: Graivoron, Aug. 7, 1938, during May-June, 1939, emerged 4 ♂♂ and 11♀♀; same place, Oct. 10, 1940, during May-June 1941 emerged 7 ♂♂ and 7 ♀♀; B. Troitsa, Sept. 17, 1938, during May, 1939, emerged 4 ♂♂ and 2 ♀♀; Valuiki, Oct. 15, 1939, during May-June 1940 emerged 22 ♂♂ and 50 ♀♀; Borisovka, April 25, 1941, during May-June of the same year emerged 7 ♂♂ and 17 ♀♀; Krasnaya Yaruga, May 10, 1947, during the same year emerged 4 ♂♂ and 14 ♀♀.

Aulacidea macula R. Fors.

Galls of this species were collected from inflorescences of Scorzonera purpurea L. on June 26, 1951 by A. Piterskaya in the state reservation Streletskaya Step' in the Kursk region. During the month of June of the following year 4 ♀♀ emerged from the galls.

Aulacidea pigeoti (Kieff.)

Kursk, Sept. 30, 1938, galls on Tragopogon pratense L., during May, 1939 emerged 7 ♂♂ and 12 ♀♀; Glushkovo, Kursk region, Aug. 1, 1937, on Tr. majus Jacq., immature galls, gall wasps did not emerge. Graivoron, Belgorod region, May 10, 1937 on Tr. majus Jacq., gall wasps emerged starting on May 16, and more intensely from May 25; in all emerged 6 ♂♂ and 38 ♀♀; same place, May 12, 1939 on Tr. orientale L., emergence from May 15 to 20, in all 5 ♂♂ and 5 ♀♀; same place, May 5, 1946, during this month of the same year emerged 9 ♂♂ and 62 ♀♀.

The exact delineation of the 2nd and 3rd abdominal segments in all of this specimens was not distinct.

Aulacidea pilosellae (Kieff.)

Kursk, galls collected on July 30, 1936 and May 1, 1958 from veins on leaves of Hieracium pratense Tausch. and of H. echioides W. et K.; during June, 1937 and 1958 emerged in all 7 ♂♂ and 60 ♀♀.

Bayan-aul, Pavlodar district, Aug. 25, 1930, on Hieacium sp.; during May, 1931 emerged 1 ♂ and 1♀.

Previously reported in Voronezh from Hieracium pilosella L. (Vanin and Vanin, 1927: 757).

Aulacidea hieracii (L.)

Mga Leningrad region, May 25, 1937, Dombrovskaya, 4 ♀♀.

Khvoinaya, Novgorod region, May 30, and Aug. 20, 1935, galls on Hieracium umbellatum L., from which emerged 9 ♂♂ and 101 ♀♀.

Vologodskaya region: village Nelazskoe, Cherepovet district, Oct. 10, 1936; during May, 1936 emerged 3 ♂♂ and 13 ♀♀; Suda, Cherepovet district, Oct. 12, 1935; during May,1936 emerged some parasites and 23 ♂♂ and 99 ♀♀; Cherepovets, galls from Sept. 20 to Oct. 24, 1935, during May, 1936 emerged 14 ♂♂ and 17 ♀♀, all collected from Hieracium umbellatum L.

Podol'sk, Moscow region., Sept. 27, 1956, galls on Hieracium umbellatum L.

Kursk region: Ryl'sk, Aug. 28, 1955, on H. umbellatum L.; Kursk, April 30, 1937 and April 24, 1938, on H. umbellatum L.

Belgorod region: Belgorod, Aug. 15, 1937, April 14, 1938 and Oct. 30, 1945, on H. bauhini Schult., 122 ♂♂ and 216 ♀♀ emerged in addition to some parasites; Graivoron, May 10, 1937, 2 ♀♀; Urazovo, Aug. 2, 1947 and Oct. 15, 1951, on H. virosum Pall.

Saratov, Oct. 25, 1957, on Hieracium sp., during June,1958 emerged 12 ♂♂ and 20 ♀♀.

Omsk, July, 1929.

Chuvashi, northern district of Novosibirsk region, Jan. 28, 1935, on Hieracium sp., 1 ♂ and 1 ♀ emerged.

Bogoyavlenka, Pavlodar region, June, 1929, (A. Smelova).

This author collected galls of this species on Aug. 12, 1944 in Norway, in the vicinity of Valebu in the province of Telemark.

This species has been previously reported from the Tula region, (Trusova, 1915), Voronezh, (Vanin and Vanin, 1927), Saratov region, (Silant'ev, 1894), Stavropol region, (Belizin, 1928), Georgia, (Rubsaamen, 1895).

Aulacidea subterminalis Niblett

This species is distinguished from others of the same genus by the presence of stipples on the head and mesonotum. It forms inconspicuous galls on rooted vegetative runners of Hieracium. Galls are found under leaf rosettes, at the base of leaf petioles, less frequently on the central leaf veins, and directly on the lower surface of the prostrate stems of the shoots.

Kursk region: Ponyri, Sept. 25, 1957, galls on H. pratense L., during June, 1958 1 ♀ emerged. Belaya, Aug. 10, 1958, galls on H. cimosum L., 3 ♀♀ emerged 5 days later.

Aulacidea verticillica, V. Belizin, sp. nov.

Male and female. Head and thorax black or very dark brown; clypeus and maxillae red; abdomen usually light yellowish red, sometimes darker, brown; only two first segments black; legs light colored, yellow, with dark terminal segments of the tarsi.

Head smooth, shiny. Frons from the antennae to the clypeus with a smooth shiny elevation. Numerous fine furrows spread in a fan-like manner from the clypeus and maxillae. Eyes black, very convex, narrowing in the lower parts. Ocelli very small, brown. Antennae of the female 12-segmented, hardly reaching the beginning of the abdomen with their apex; 1st segment pear-shaped, 2nd rounded, somewhat elongate; flagellar segments almost straight, each a little spread at the top; 1st flagellar segment shorter than the 2nd; both of these are thinner than the following segments, which gradually become shorter; last segment tapering, $\frac{1}{3}$ or $\frac{1}{2}$ times as long as

the penultimate. Antennae of the male 14-segmented, reaching the beginning of the abdomen or even beyond; they are thread-like, the segments becoming shorter and thinner toward the apex. Flagellar segments straight, cylindrical, only the 1st one somewhat curved; last segment 1½ times as long as the penultimate.

Pronotum dull, delicately leathery, with dense, small stipples; propleura similar in relief to pronotum. Mesonotum shiny, smooth with a few stipples, especially near the pronotum. Parapsids very narrow and small, distinct from the scutellum to the middle portion of the mesonotum. Mesonotum with a short shallow depression near the scutellum, between parapsids. Two parallel, very fine and delicate furrows in the anterior half of the mesonotum, between parapsids. Mesopleura convex, riddled with sharp longitudinal furrows. Scutellum dull, convex, delicately wrinkled; two narrow, smooth, obliquely disposed pits at the base of the scutellum; the posterior portion of the scutellum, descending toward the intermediate segment, is shiny and smooth.

Wings slightly smoky, densely covered with short hairs. Veins distinct. Third portion of the subcostal vein and the first and second portions of the radial vein are curved. Areola quite large, distinct; cubital vein well defined almost to the margin of the wing. First tarsi 1½ times as long as the tibiae; posterior tarsi almost equal in length to the tibiae. Abdomen smooth, shiny. Body length of the male 1.2 mm, of the female 1.6 mm.

Types and paratypes, in all 2 males and 7 females, reared during May, 1948 from galls on Salvia verticillata L., collected by the author on Sept. 1, 1947 in the vicinity of Kursk. All specimens are kept in the collection of the Institute of Zoology, AN SSSR in Leningrad.

This species is most closely related to A. andrei (Kieff.), but is distinguished from it by the 12-segmented antennae of the female and a lighter colored shade of the antennae, legs and abdomen.

Galls formed on the floral receptacle of Salvia verticillata L. and are really hypertrophied seeds, they are more expanded and larger than the regular seeds. Galls leathery, thin-walled, single, yellowish brown, smooth, 3-4 mm in length and 2 mm in width; sometimes the surface of the galls is covered by a well-developed design consisting of thin, dark veins. The top part of the galls is constructed and it is elongated into a triangular, ribbed hood; sometimes this hood is very small, but often it reaches $\frac{1}{3}$ or even $\frac{1}{2}$ the total length of the gall.

Aualcidea scorzonerae (Gir.)

Galls were collected by the author on Scorzonera sp. in Fedorovka, Pavlodar region, during May, 1929.

Aulacidea tragopogonis (C. Thoms.)

Galls often inside the stems of different species of Tragopogon. Collected by the author in the following localities:

Kanev, Kiev region, July 28, 1940, galls immature. Saratov, Oct. 25, 1957, during June, 1958 emerged 30 ♂♂ and ♀♀.

Kursk region: Dmitriev, Sept. 14, 1947, on T. majus Jacq., during May 1948 emerged 11 ♂♂ and 27 ♀♀; Oboyan', Sept. 30, 1945, on T. majus Jacq., from these during May, 1946 emerged 1 ♂ and 4 ♀♀; Rzhava, Oct. 14, 1953, on T. majus Jacq., during the month of May of the following year emerged 3 ♂♂ and 3 ♀♀. Belgorod region: Krasnaya Yaruga, May 10, 1947, during May of the same year emerged 4 ♂♂ and 8 ♀♀; Borisovka, Oct. 10, 1940, on Tr. pratensis L., from the galls during May 1941 emerged 2 ♂♂ and 10 ♀♀; Graivoron, Aug. 7, 1938, on Tr. pratensis L., April 24, 1939 on T. majus Jacq., from these galls during May, 1939 emerged 17 ♂♂ and 28 ♀♀; Belgorod, Oct. 30, 1945, on Tr. orientale L., from which during May of the following year emerged 4 ♂♂ and 19 ♀♀; Urazovo, April, 1951, 1 ♀.

Aulacidea cacaliae V. Belizin, sp. nov.

Male and female. Head and thorax black; antennae, maxillae, legs and abdomen of a single color, yellowish red or reddish brown.

Head faintly shiny, leathery; frons with furrows diverging in a fan-like manner. Antennae of female 13-segmented, 3rd segment equal in length to the 4th, but thinner than it; flagellar segments, beginning with the 6th gradually taper toward the apex; last segment more than twice as long as the penultimate. Antennae of male 14-segmented; 3rd segment somewhat shorter than the 4th.

Pronotum and propleura with flat grey hairs, leathery, faintly shiny. Mesopleura shiny with numerous sharp furrows. Metapleura bare, leathery. Mesonotum faintly shiny, delicately leathery. Parapsids distinct along

the entire length, as far as pronotum. Anterior parallel furrows short, deep; a wide and deep median furrow near the scutellum; lateral furrows narrow, but distinct. Scutellar pits deep, round, faintly shiny; discus wrinkled rougher than the mesonotum. Wings smoky, densely hirsute; radial cell narrow and long, more than 2½ times as long as it is wide. Areola small, but distinct.

Abdomen smooth, shiny; sides of the 2nd tergite bare.

Length of body 2.2-2.5 mm.

Types and paratypes: Tun'sha, Primor'e region, June 8, 1941, from galls on Cacalia hastata L., 3 ♂♂ and 20 ♀♀. (K. Grunin). In addition to this, K. Ya. Grunin collected in the following localities of the Primor'e region: river Koembe, May 31, 1941, from galls on Cacalia hastata L. emerged 5 ♀♀; eastern slope of the central Sikhotė-Alinya, Ternei district, May 18, 1936, galls on C. hastata L., 30 ♀♀ emerged from May 29 to June 6, 1936.

Mongolia: Sutszukte gorge in southwestern Kentee, 1 ♂ and 9 ♀♀ emerged from June 1, to July 15, 1925, (Kozlov).

All the specimens are kept in the collection of the Institute of Zoology, AN SSSR in Leningrad.

This species is distinguished from A. abdominalis (C. Thoms.) by the uninflated genae, absence of scabby lines on the temples and on pronotum and of hairy spots on the abdominal tergite.

Phanacis Foerster

Radial cell closed; scutellum without distinct pits at the base, only with transverse furrows, not closed on the sides; parapsids absent in front; areolae present. Galls on Centaurea, Carthamis and Phlomis.

Phanacis centaurea (Kalt.) Foerst.

The following numbers of gall wasps were reared from the stems of Centaurea scabiosa L., collected by the author in the Kursk and Belgorod regions:

Kursk region, Ryl'sk, during May, 1955 reared 4 ♀♀; Sudzha, 13 ♀♀ emerged during June, 1958.

Belgorod region, Bol' shetroitsa, during May, 1939 reared 24 ♀♀; Graivoron, during the period May 15-20, 1939 emerged 19♀; Belgorod, during May, 1946 reared 10 ♀♀.

Galls of Ph. centaureae (Kalt.) Foerst. are concealed within the stems of Centaurea scabiosa L., C. nigra L., C. rhenana Bor., C. jacea L. They represent a compact, rounded hardening of the pith, which is the larval chamber, and usually is located near the internal wall of the stem. Such galls are completely unseen from the outside, and their presence may be determined only by splitting the stems lengthwise. In practice it is possible to collect these insects during the end of summer (August-October) by cutting the stems and collecting whole floral anthodia containing seeds inside of various species of field cornflowers (Centaurea L.), and by placing them, each species separately, into jars or paper bags; in many cases gall wasps of the genera Phanacis of Isocolus will emerge. It is also desirable to examine stems and floral anthodia of other Compositae (Chartolepis Cam. Inula L., Jurinea Cass., Seratula L., Acroptilon Cam., Phaeopappus Boiss., Amberboa DC., Phalacrachena Ilj., Carthamus L., Picris L., Barhhausia Moench, etc.) for the same purpose.

Phanacis carthami V. Gussakovskij

It is considered necessary to repeat the description of this gall wasp, made originally by V. Gussakovskii (Rodd et al., 1933), but which remained not generally known because it appeared in a publication with a limited circulation.

Female. Black, antennae and legs russet colored, apex of antennae brown, femora (expecially at base) somewhat darkened; head and entire thorax, including scutellum, almost dull, delicately, densely and distinctly wrinkled, punctate; genae quite wide (wider than ½ of the diameter of the eye); scutellum with a shallow, but quite wide furrow at its base, the furrow not interrupted in the middle, and not framed in the back; scutellum convex and rounded at its apex.

Mesonotum with two furrows, (parapsids), beginning at the sides from the base of the scutellum and terminating in the first third. Intermediate segment finely and densely wrinkled, with two thin ribs which originate at its base and diverge posteriorly; abdomen slightly compressed laterally, with unretracted apical segments, last

sternite strongly compressed laterally and protruding backward in a triangle, with a short spine at the apex.

Antennae thin, 13-segmented, all segments, not excluding the 2nd, considerably longer than they are wide. Wings transparent with the radial cell completely closed. Length of body 1.7-2.0 mm.

The safflower gall wasps winters in the larval stage in galls on the roots of the safflower. During the end of April - beginning of May the wintering larvae pupate,and soon the adult insects emerge; these make a round emergence opening in the gall wall, and reach the exterior. Adult gall wasps remain on the safflower rosettes, in their central portions. In nature, (Kammashi, Uzbek SSR, 1931), the safflower gall wasps appeared on May 5, at once in large numbers and remained till May 24.

Apparently the gall wasps lay their eggs during this period, but the oviposition remained unobserved, and even the place of oviposition was not discovered. It seems that the gall wasps reach the ground along the cracks in the stem and lay their eggs in the roots.

Galls, which were found at a depth of up to 7 cm below the surface, but usually not so deep, are unilocular, (single), although often several of them are grouped together, and lie within the woody portion of the root. Whenever the larval chambers are grouped together, there is often seen a thickening of the root, making if several times as thick as the uninjured part.

First galls on safflower seedings in the Krasnovodopadskoe experimental field in the year 1927 were found on May 9.

It is possible that the safflower gall wasps have more than one generation, as on June 7 some galls were found with emergence openings, but it was not established whether the openings were made by the safflower gall wasps or by some parasites which live on their larvae.

The extent of damage produced by these gall wasps has not been established. Superficially, the damaged plant is indistinguishable from the healthy one, except for the presence of the galls. There has been no experimental work in this direction.

The following specimens of this species are kept in the Institute of Zoology, AN SSSR in Leningrad: Kammashi, Uzbek SSR, May 6, 1931 (A. Rodd), 2 ♀♀ and 1 ♂; same place, April 29 to July 3, 1932 (V. Gussakovskii), 6 ♀♀ and 2 ♂♂.

Phanacis phlomidis V. Belizin, sp. nov.

Female. Black, only the head dark brown, antennae and legs yellowish red; hypopygium smoky.

Head dull, densely covered with short light colored hairs; clypeus bare, shiny, convex; maxillae and the adjacent lower margins of genae yellowish or reddish brown, with dark teeth. Antennae 13-segmented; first two segments yellow, the rest light brown, 1st segment thickened, long; 2nd segment somewhat thinner and half as long as the 1st; 3rd segment thin, slightly curved, half as long as the 4th, which is just as thin as the 3rd, but straight; 5th segment a little shorter than the 4th, equal in length to the remaining ones; all the segments, beginning with the 5th, thickened, vaguely club-shaped; last segment as long as the two preceding ones, taken together.

All the pleura dull, similar in relief, coarsely stippled. Mesonotum leathery, shiny with transverse wrinkles. Parapsids narrow, but deep and distinct along more than half of the mesonotum, and sometimes distinct as far as its anterior edge. Two short, distinct, parallel furrows in the anterior part of the mesonotum, between the parapsids. Posterior lateral furrows, (external to parapsids), deep and distinct, extending to half the length of the mesonotum. Posterior edge of the mesonotum divided from the scutellum by a smooth, curved, deep furrow. Scutellum of a similar texture as the mesonotum; at its base there are two oblique, transverse furrows; discus flat, almost circular, its posterior edge somewhat elevated.

Legs of one color, light, only the bases of all the coxae darker, light brown in color. Second segment of posterior tarsi considerably longer than the last one. Wings transparent, with dense microscopical microtrichia. Veins distinct, brown in color. Radial cell closed along its anterior border, narrow, 2½ or 3 times as long as it is broad. Areola, cubital and anal veins distinct.

Abdomen as long as the head and the thorax taken together, sometimes shorter, smooth, shiny, with a very broad upper surface. Hypopygium smoky; ventral spine short, and dull at the apex.

Length of body 2.2 mm.

Male. Reddish brown, only eyes, ocelli and the apex of abdomen are blackish. All the sutures connecting the sclerites of the thorax are darker, reddish brown.

Head very massive, considerably wider than the narrow thorax; it is leathery, somewhat shiny. Antennae 14-segmented, reaching the base of abdomen with their apex. 3rd segment thin, curved, almost twice as long as the 2nd, and $1\frac{1}{2}$ times as long as the 4th. Flagellar segments, except the 1st one, are cylindrical, straight, and almost equal in length to each other; only the last segment, which is pointed at the tip, is longer than the penultimate.

Thorax dull, very slightly shiny, almost entirely of the same texture, leathery. Mesonotum slightly more shiny, with dense, very short light colored hairs. Parapsids narrow and thin, but distinct almost to the anterior border of the mesonotum. Scutellum divided from the mesonotum by a deep, semicircular furrow, whose bottom is very delicately wrinkled in a net-like manner; discus slightly convex, a little pointed conically at its apex. The sides of the intermediate segment, between the middle of the metapleura and the apex of the scutellum, with an elevation, in the shape of a bump with a pointed top. The median field of the intermediate segment narrower, but not shorter than the scutellum; it is concave, bordered on the sides by two elevated, narrow, parallel ridges.

Forewings reach with their apex only the middle of the 2nd segment of the abdomen; the following veins are distinct: subcostal, radial, basal and cubital.

Legs of one color, yellow, lighter than the rest of the body.

Abdomen shiny, smooth, equal in length to that of the thorax.

Length of body 2.0 mm.

Types and paratypes, in all 1 ♂ and 11 ♀♀, reared during May, 1948 from stems of Phlomis tuberosa L., collected by the author in Sudzha, Kursk region. All these specimens are kept in the collection of the Institute of Zoology, AN SSSR in Leningrad.

This species is very closely related to Ph. centaureae (Kalt.) Foerst., but it is distinguished from it by the following characteristics:

Female – by the coarsely stippled mesopleura; by the presence of parallel furrows between the parapsids in the anterior part of the mesonotum; by a longer radial cell, $2\frac{1}{2}$-3 times as long as it is broad; by a shorter 5th antennal segment, which is shorter than the 4th, but as long as the 6th, and not longer than it; by very long 2nd segments of posterior tarsi, which are longer than the last segments.

Male – by a very massive head, broader than the thorax; by the short 2nd antennal segment, which is shorter than the 4th; by the short forewings, which reach with their apex only to the middle of the second abdominal segment; by the more developed venation of the forewings, which have in addition to the subcostal and the radial veins, also the basal and the cubital veins; by the presence of an outgrowth on either side of the intermediate segment, pointed on the top.

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NEW SPECIES OF THE GENUS CULICOIDES (DIPTERA, HELEIDAE) FROM THE SOUTHERN REGIONS OF THE USSR

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When examining collections of midges from Central Asia, Caucasus and the Crimea, 4 new genera and 3 species werefound to be new for the fauna of the USSR. In addition to this we are now able to give a fuller description of a species which was earlier described without sufficient detail.

Culicoides desertorum Gutzevich, sp. n. (Fig. 1)

Female. Eyes do not touch each other. The width of the frontal area equal approximately to twice the diameter of the eye facet. Dorsal transverse suture angular, ventral one absent, longitudinal suture usually present. Antennal index about 1,1. Palpi: the length of the 3rd segment exceeds its maximum width 2-2½ times, sensory organ cup-shaped with one large opening, which exceeds the size of the facet.

Mesonotum golden colored, without spots or dots. Wings with large light colored spots, which often coalesce. Second radial cell entirely dark, seldom dark with a light apex, as in C. pictipennis Staeg., which this species resembles to a certain extent, according to the wing pattern. Light spots in the basic portions of R_5, in M_1, M_2 and Cu almost equal in size and lie in approximately the same lines. Of the three light spots at the wing apex, the anterior one is considerably bigger than the others. Macrotrichia, which cover almost the entire wing, are present in the basal cell. Length of wing 1,1-1,2 mm. Tibiae with smooth light colored rings.

Spermatheca single, egg-shaped, large, measuring 80-95 × 55-70 μ.

Male hypopygium. 9th tergite elongate, lateral outgrowths conical, slightly divergent between these there aretwo well-developed tubercles. 9th sternite with a deep incision. Ventral coxital outgrowth absent. Parameres some what thickened in the beginning of the middle third, then taper gradually; the thread-like ends of the parameres bent at right angle. The height of the aedeagal arch exceeds its width. Membrane with spines.

This speices belongs to the "circumscriptus group", and it is distinguished from the related species by the following characteristics:

Characteristics	C. desertorum	C. salinarius Kieff. and C. circumscripts Kieff.
"Stipples" small dark spots at the points of origin of mesonotal hairs	Absent	Present
Anal cell	One light spot in the apical half	Two light spots in the apical half
Light spots in the third quarter of the wing	Disposed almost in a straight line	Do not form a straight line
Posterior edge of the 9th tergite	With two bumps, (in addition to the lateral outgrowths)	Bumps absent

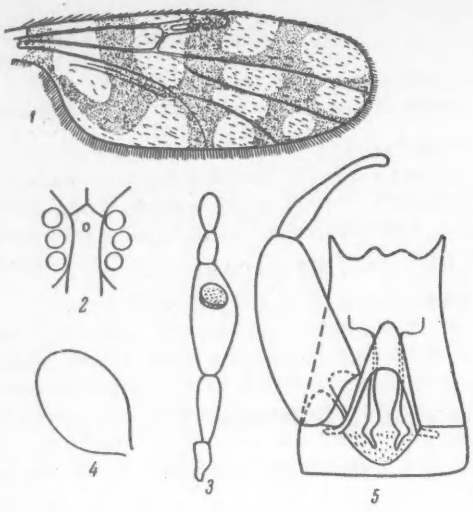

Fig. 1. Culicoides desertorum Gutzevich, sp. n. 1) Wing; 2) frontal area; 3) palpus; 4) spermatheca; 5) male hypopygium.

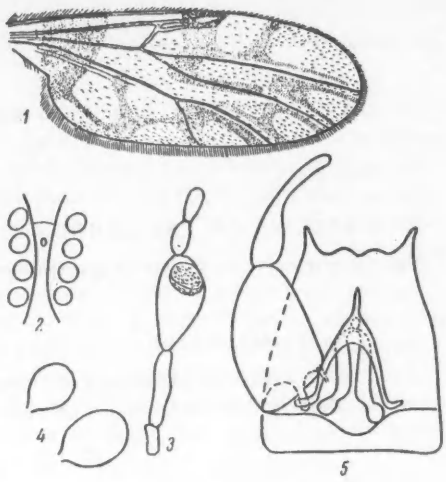

Fig. 2. Culicoides caspius Gutzevich, sp. n. 1) Wing; 2) frontal area; 3) palpus; 4) spermathecae; 5) male hypopygium.

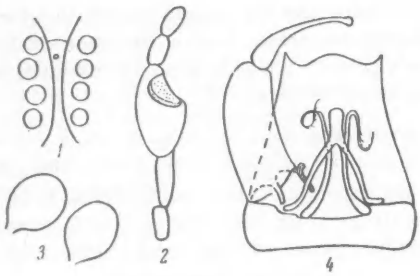

Fig. 3. Culicoides tauricus Gutzevich, sp. n. 1) Frontal area; 2) palpus; 3) spermathecae; 4) male hypopygium.

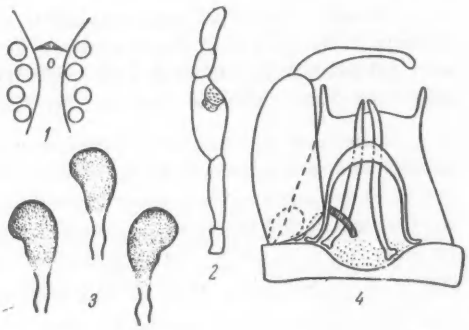

Fig. 4. Culicoides turkmenicus Gutzevich, sp. n. 1) Frontal area; 2) palpus; 3) spermathecae; 4) male hypopygium.

Material: Kunya-Urgench, Turkmen SSR, Oct. 7-10, 1951, 79 females; Tashauz, Turkmen SSR, Oct. 13-17, 1951, 4 females (collected by P. A. Petrishcheva, preserved in alcohol); village Kokaity near Termez, Uzbek SSR, August, 1954, 10 males and 86 females (collected by A. N. Skrynnik in a house with the insects attracted to a light, dry specimens).

Culicoides caspius Gutzevich, sp. n. (Fig. 2)

Female. Eyes do not touch each other. Frontal area narrow, its width less than the diameter of the eye facet. Dorsal transverse suture straight; ventral transverse and longitudinal sutures absent. Antennal index about 1.1. Palpi: 3rd segment very thickened, its length exceeding its maximum width about 2 times. Sensory organs of the palpi saucer-shaped, 1½ times the size of the facet.

Mesonotum grey with a golden tinge. Indistinct brown spots, one or two on each side of the mesonotum, in some specimens. Scutellum brown. Wings with cream colored light spots. The size of these spots varies to the extent that the light color becomes dominant, and upon it, as a background, dark lines of irregular shape stand

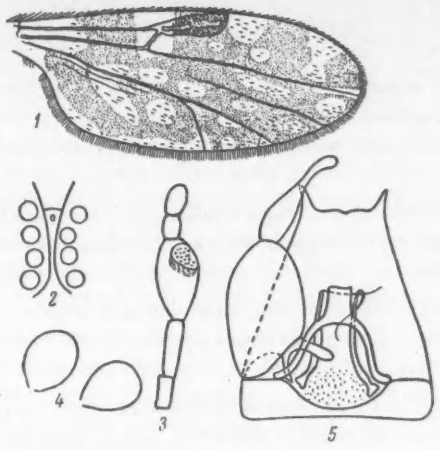

Fig. 5. Culicoides schultzei End. 1) Wing; 2) frontal area; 3) palpus; 4) spermathecae; 5) male hypopygium.

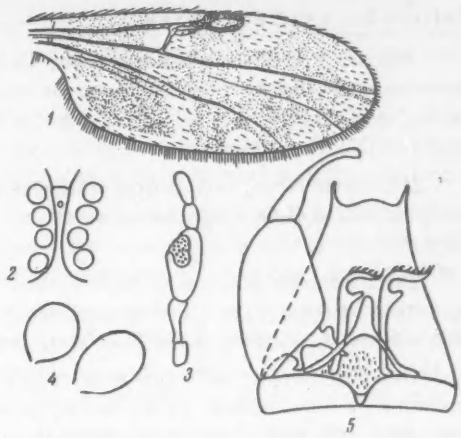

Fig. 6. Culicoides similis C. I. M. 1) Wing; 2) frontal area; 3) palpus; 4) spermathecae; 5) male hypopygium.

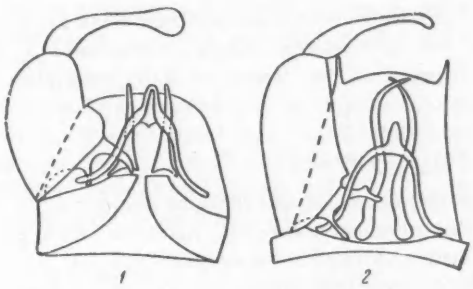

Fig. 7. Hypopygium of the males of Culicoides scoticus Dow. Ket. (1) and of Culicoides saevus Kieff. (2).

out. Second radial cell entirely dark. The space between the light spots in R_5 has the shape of a dark band with a tapering appendage, which proceeds toward the wing apex parallel to the medial vein. Spots near the apex have the shape of an incomplete circle or oval; the most anterior one of these, i.e., the one within R_5, is 2-2½ times as big as the others. Two light spots in the apical portion of the anal cell. Macrotrichia cover the entire wing, except its base; they are absent in the basal cell. Length of wing 1.2-1.4 mm. Tibiae with smooth light colored rings.

Two spermathecae, which are broad, egg-shaped, resembling each other in shape but different in size; their length is about 35 and 45 μ respectively.

Male. Wing coloration as in the female, but the light spots do not have a creamy color. Both spots in the apical portion of the anal cell are coalescent with one another.

Hypopygium. 9th tergite at its base almost twice as broad as it is at the apex; posterior edge of the tergite with an incision and two small protrusions; lateral outgrowths large, divergent. 9th sternite with a small incision. Ventral coxital outgrowth finger-like, tapering at the tip. Parameres very broad in the entire middle portion, narrow and curved in the apical third, ends thread-like. Aedeagus: the height of the arch greater than its width, middle portion terminates in a thin finger-like protusion. Membrane without spines.

Material: Gudermes, Groznyi region. June 28-July 10, 1954, 3 males and 7 females, (collected by attraction to a light, dry specimens).

This midge belongs to the "pictipennis group". It is distinguished from C. pictipennis and from other species of this group by the large size of the anterior light spot in the apical portion of the wing, and by the structure of the spermathecae, (which are unequal) and the male hypopygium (wide parameres, middle part of the aedeagus with a finger-like protrusion).

Culicoides tauricus Gutzevich, sp. n. (Fig. 3)

Female. Eyes do not touch each other. Frontal area about 1½ times as wide as the eye facet. Dorsal transverse suture slightly curved; ventral transverse and longitudinal sutures absent. Antennal index near 1. Palpi: 3rd segment thickened, it is 2-2½ times as long as it is wide; sensory organ relatively small, its opening not bigger than the facet.

Mesonotum brown, without spots or stipples, scutellum the same. Wings without spots. Macrotrichia cover the major portion of the wings, but are absent from the basal cell. Length of wing 1.1-1.2 mm. Legs brown, tibiae without rings.

Three spermathecae, kidney-shaped, almost identical in shape and size, 60-65 micra in length; the middle spermatheca in front of the lateral ones. Posterior extremity of each spermatheca not sclerotized; spermathecal ducts widened at a distance of 30-35 μ from their origin.

Male hypopygium. 9th tergite short, (wider than long), twice as broad at its base than at the apex. 9th sternite with a large incision. Coxite narrow, its ventral outgrowth strongly chitinized, curved, blunt and without a protrusion. The ends of the ventral outgrowths of the right and the left coxites come near each other. Parameres shaft-like, slightly curved; bases not wider than the middle part; the ends are narrowed for a short distance, but not drawn out into threads. Aedeagal arch almost as high as it is wide. Membrane with very small spines.

Material: Gurzuf, south coast of Crimea, August 1953, 1 male and 6 females, (obtained from within a park light, dry specimens).

This midge belongs to a group of species which possess three spermathecae. It is most related to C. saevus Kieff., but is is distinguished from the latter by the shape of the spermathecae, (which are spherical in C. saevus), by the unstippled mesonotum, and by the strucutre of the hypopygium, (the description of the hypopygium of C. saevus is given below).

Culicoides turkmenicus Gutzevich, sp. n. (Fig. 4)

Female. Eyes do not touch each other. Frontal area very narrow, about half of the diameter of the facet. Dorsal transverse suture straight, ventral one absent, longitudinal sometimes present. Antennae: 4th to 10th segments almost spherical, 11th to 13th bottle-shaped, i.e., sharply narrowed at the top; index 0.9-1.0. Palpi: 3rd segment, short, very thickened, its length exceeds its width not more than 2 times. Sensory organ saucer-shaped, oval, twice the size of the eye facet.

Mesonotum without "stipples", and, as far, as could be determined from alcohol-preserved specimens, without a distinct pattern, three dark longitudinal lines are vaguely discernible. Wings without spots, first and second radial cells approximately equal in size; the veins which bound these cells are not thickened, and are covered with dark hairs. Macrotrichia cover almost the entire wing, except the basal and the costal cells. Length of wing 0.85-0.9 mm.

Two spermathecae, both spherical or egg-shaped, 35-40 μ in length.

Male hypopygium. 9th tergite elongate, 1½ times as wide as the base than it is at the apex; posterior edge of the tergite somewhat convex, without an incision; lateral outgrowths short. Coxite relatively narrow, its ventral outgrowth has a tubercle at the base; the apical portion of the outgrowth is finger-like, blunt at the tip. Parameres of almost equal width, forming a sharp curve in the apical third, ends thread-like with a few delicate branches before the apex. Aedeagal arch almost as high as it is wide.

The material was received from P. A. Petrishcheva from Turkmenia: Molla-Kara, Tashauzskaya region, Oct. 4, 1951, collected on herself, 75 females in alcohol; same place, Nov. 10, 1951, collected from sticky leaves on bushes 2 males.

Of the other species with spotless wings, this midge most resembles C. albicans Winn. and C. heliophilus Edw., from which it differs by the structure of the frons (in C. albicans the eyes touch each other) and of the palpi (in C. heliophilus the 3rd segment is slightly thickened). C. albicans and C. turkmenicus are identical in the structure of the hypopygium, but in the former the posterior edge of the 9th tergite has a small incision, and in the latter it is slightly convex, without an incision.

Culicoides schultzei Enderlein (Fig. 5)

This is a species that is new for the fauna of USSR. It is easily distinguished by the sharpness of the wing pattern and by the presence of four light spots in R_5.

Female. Eyes do not touch each other, the width of the frontal area does not exceed the diameter of the facet. Dorsal transverse suture straight, ventral transverse and longitudinal sutures absent. Antennal index near 1.0. Palpi: 3rd segment very much thickened, the aperture of the sensory organ slightly bigger than the facet.

Coloration of the mesonotum very variable. There are dark brown spots, irregular in shape, on a greyish brown background. In addition to this there are small dark spots at the places of attachment of hairs – "stipples". In some specimens the stippling is indistinguishable. Scutellum yellowish grey wtih a dark spot in the middle.

Wings with very sharp, small, light colored spots of irregular outlines. There is a double spot in R_5 in the apical portion, and three spots in the basal half; a bigger one in front, near the edge of the wing, and two smaller ones behind, sometimes coalescing with the front one. Two spots in the medial cell, two in the cubital cell, distinct or connected to each other. Relatively small macrotrichia are limited to the apical half of the wing. Length of wing 1.0-1.1 mm.

Legs yellowish brown with white rings in the basal third of the tibiae. Two spermathecae, equal to size, egg-shaped.

Male hypopygium. 9th tergite elongate, narrowing considerably, posterior edge with a small depression; lateral tergital outgrowths divergent, conical. 9th sternite with a deep incision. Coxite shorter than the 9th tergite; ventral coxital outgrowth large, tapering at the tip. Parameres thin, sharply bent in the apical half, with thread-like ends. Aedeagus arch wide, almost flat, at the apex, the middle part cylindrical in shape. Membrane with spines.

Material was obtained by A. N. Skrynnik by means of attracting the insects to a light in a house, village Kokaity near Termez, Uzbek SSR, August 1954. A specimen belonging to this species was found in our collection from Shakhi, northern Iran, Mazanderan Province, July 1, 1942, among insects removed from within a lampshade in a dwelling. Geographical distribution of C. schultzei, according to literature data: China, Japan, some countries of southeast and south Asia, Africa.

Culicoides similis Carter, Ingram et Macfie (Fig. 6)

According to the wing coloration it is identical to species of the "pictipennis group", but is easily distinguished from them by the hypopygeal structure, (parameres with a lateral protrusion).

Female. Eyes do not touch each other, frontal area narrow, smaller than the diameter of the facet. Dorsal transverse suture straight; ventral transverse and longitudinal sutures absent. Antennal index about 1.3. Palpi: 3rd segment much thickened, its length exceeds its width approximately twice; sensory organ with a shallow cavity, whose aperture is somewhat bigger than the size of the facet.

Mesonotum with a pattern formed by a combination of chocolate colored brown and light grey areas; the former form, as it were, a lattice of longitudinal and transverse lines, which bound the lighter areas, round or irregular in shape. The shape and size of the spots vary. According to the wing coloration C. similis on the whole resembles C. odibilis Aust., but differs as there is no light spot on the anterior branch of the medial vein. Macrotrichia cover a greater part of the wing, whose length is 1.1-1.3 mm.

Two spermathecae, unequal: the larger one, measuring about 60 μ, is egg-shaped; the smaller one, measuring 45-50 μ, is egg-shaped or spherical.

Male hypopygium. 9th tergite very much narrowed toward the apex, its posterior edge convex, without an incision; lateral outgrowths parallel or slightly convergent. 9th sternite with a narrow incision. Coxite with a shoe-shaped ventral outgrowth. Parameres very peculiar: there is a blunt lateral outgrowth at the border between the middle and the apical thirds; the relatively wide apical portion is comb-like, bearing 4-7 thin spines. Aegeagal arch wider than high, middle portion is conical. Membrane with spines.

This species, apparently, is widely distributed in the south of USSR. There are specimens from Yalta, Gurzuf, Sukhumi, Gudermes (Groznenskaya region), Prishiba (south Azerbaidzhan), as well as from Shakhi in

northern Iran, (collected by attraction to light). Culicoides similis is known from Africa, south and southeast Asia. In spite of certain differences in the patterns of the wing and the mesonotum, as compared with the original description of C. similis, we temporarily assign our specimens to this species, basing our decision mainly on the similarity of the hypopygeal structure.

Among insects collected by A. N. Skrynnik, by attraction to light, in Kokaity, near Termez, there were male and female midges, which morphologically correspond to the above description, but differ very much in the coloration of the thorax. Mesonotum is golden brown, almost of solid color, and only in its anterior half, on the sides and near the scapular pits, there are indistinct dark brown lines. There are certain differences also in the detail of the wing pattern: the light spot in the basal part of the medial cell is irregular in shape, and from it, along medial veins, proceed narrow, light lines; the spot in the apical part of the anal cell is without a bridge. It is possible that this is another species, (or a subspecies of C. similis?).

Culicoides scoticus Downes et Kettle (Fig. 7, 1)

This species is very much related to the widely distributed species C. obsoletus Mg. The only known difference is in the structure of the hypopygium. 9th sternite is quite peculiar: a deep triangular incision of the anterior edge (and not the posterior, as in other species), divides it into two distinct parts. The short coxite is much thickened at its base. The vental coxital outgrowth is large, slightly curved, wide at the base and tapering toward the apex. Other parts of the hypopygium as in C. obsoletus.

Material: description based on material from Scotland (Downes and Kettle, 1952); found for the first time in USSR. 2 males found among midges extracted from the shade of a street light in Sukhumi, Oct. 20, 1953; specimens received from T.Ya. Avdeeva.

Culicoides saevus Kieffer (Fig. 7, 2)

This species is easily distinguished by a combination of two characteristics: a stippled mesonotum and wings without spots. However, the coloration of the thorax in this species is very variable. Sometimes the stippling is weak or quite invisible, as, for example, in some of the specimens from the Termez district. In such cases identification is possible by means of a microscopical study. Females are distinguished from all species known in USSR by the presence of three spermathecae of spherical shape. Males are characterized by a peculiar structure of the hypopygium, a description of which is given below.

The base of the 9th tergite is much wider than its remaining portion, the posterior edge of the tergite is convex or straight, without an incision; lateral outgrowths divergent or parallel, varying in size, sometimes very long. 9th sternite shaped like a curved plate, with the convexity pointing forward; the incision in the posterior edge is not deep, indistinct, sometimes absent. Ventral outgrowth of the coxite is wide, with a tubercle on the posterior surface, (sometimes the tubercle is hardly discernible), the ends of the outgrowths of the right and left coxites approach each other. Parameres are almost straight sclerotized shafts, their ends slightly bent and narrowed, but not sharp. Aedeagus arch almost as wide as it is high, middle portion is a small chitinized protrusion. Membrane without spines.

The first preliminary list of representatives of the genus Culicoides found in USSR by different authors included only 23 species (Gutsevich, 1952). During the past few years the list of bloodsucking midges found in the USSR has been considerably augmented (Gutsevich, 1953; Remm, 1956, Amosova, 1957; Glukhova, 1957; Krivosheina, 1957), and at present it includes, together with the ones in this paper, 48 species of Culicoides. The name of one of them, C. orientalis Gutz., 1952, must be changed, as this name has already been used for the description of a Malayan midge, (C. orientalis Macfie, 1932). A new name is hereby suggested – Culicoides bisulcatus, nom. n.

SUMMARY

The article comprises a description of a) four new species of bloodsucking midges of the genus Culicoides: C. desertorum (Turkmenistan, Uzbekistan), C. caspius (Groznyi region), C. tauricus (south coast of Crimea) and C. turkmenicus (Turkmenistan); b) three species of Culicoides new to the fauna of the USSR: C. schultzei End. (Uzbekistan), C. similis C. I. M. (Crimea, North Caucasus, Transcaucasia Central Asia, C. scoticus Dow. et Ket. (Abkhaz); c) one species of which there hitherto has been no adequate description, viz., C. saevus Kieff. (Transcasia, Central Asia).

The number of known species of Culicoides found in the USSR has thus increased to forty-eight.

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THE ESTONIAN SPECIES OF THE GENUS ATRICHOPOGON KIEFFER (DIPTERA, HELEIDAE). I. SUBGENUS PSILOKEMPIA ENDERLEIN

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The genus Atrichopogon comprises small, stocky sand flies. Several species of the genus are very widely distributed in the Palaearctic; a few species frequently occur in very large numbers, especially in damp places. From the closely related genus Lasiohelea Kieff. they are easily distinguished by the fringing on the wings. In the species of Atrichopogon macrotrichia are lacking on the wings or are present to a greater or lesser extent; in the former case they are stiffer and more prominent. In Lasiohelea the recumbent macrotrichia always cover nearly all of the wing.

The systematics of the genus has been poorly worked out because of the difficulty in distinguishing the species. The structure of the male hypopygium, which in most groups of gnats enables closely related species to be easily separated, is rather uniform in this genus, with a few exceptions. The available European keys (Kieffer, 1925; Edwards, 1926; Goetghebuer, 1933; Zilahi-Sebess, 1940) are incomplete and largely outdated.

The genus Kempia, established by Kieffer (1913) and distinguished from Atrichopogon only by the pubescence of the eyes, cannot be preserved even as a subgenus. The pubescence of the eyes in Atrichopogon, as previous authors have already pointed out (Ingram and Macfie, 1921; Edwards, 1926; Wirth, 1952), varies strongly even within the confines of the same species or population. The genus Gymnohelea Kieffer, 1921 (types of the genus: singularis Kieff. and longiserra Kieff.) differ from Kempia, according to Kieffer (1921, 1926) only by the length of the empodium and not by the absence of macrotrichia on the wings, as Edwards indicated (1929). The length of the empodium is too obscure and variable a character to serve as a basis for the distinction of even a group of species; consequently Gymnohelea, like Kempia, must be relegated to the synonymy of Atrichopogon.

Within the genus a group of species close to appendiculatus Geot. is rather clearly separable and was established by Enderlein (1936) as a new genus Psilokempia. These species, according to Enderlein, are characterized by the absence of marcotrichia on the wings and by the pubescence of the eyes. To the characteristic features of these species one may add the presence of a ventral armature and one spermatheca in the female. The males are characterized by a short first radial cell (not or barely longer then the second) and a short ninth tergite (somewhat longer than half the length of the coxite). The uniqueness and constancy of the characters mentioned show that Psilokempia End. may be considered a valid subgenus of Atrichopogon.

TABLE 1

Comparative Lengths of the Apical Antennal Segments (unit of measurement – about 2.63 μ)

	Female						Male					A. R. of female
	10th	11th	12th	13th	14th	15th	11th	12th	13th	14th	15th	
A. appendiculatus . .	11	18	19	21	20	31	16	25	26	25	35	1.3
A. nanus	11	14	20	22	24	33	15	20	26	32	43	1.2—1.3
A. avastensis	12	20	20	24	26	30	13	25	27	26	34	1.4—1.5
A. forcipatus	12	25	25	30	31	37	15	31	35	33	40	1.5—1.8

TABLE 2

Lengths of Hind Leg Segments of Female (unit of measurement – 0.01 mm)

	F	Tf	T_1	T_2	T_3	T_4	T_5
A. appendiculatus	50	47	21	9	6	5	6
A. nanus . . .	46	46	18	7	6	5	7
A. avastensis .	47	43	20	8	7	5	6
A. forcipatus .	51	48	22	9	7	5	6

So far four species of the subgenus have been found in Estonia (see below). Aside from the species known from Estonia, the following additional ones belong to the subgenus: A. articus Coq. (North America), A. armativentris Kieff. (North Africa), and possibly, also A. parvulus Kieff. (Hungary), A. nudus Zil.-Seb. (Hungary), and A. japonicus Tok. (Japan). The latter three species are known only from the females, with nothing mentioned about their ventral armature in their short descriptions.

Key to the Species

1 (8) Females.

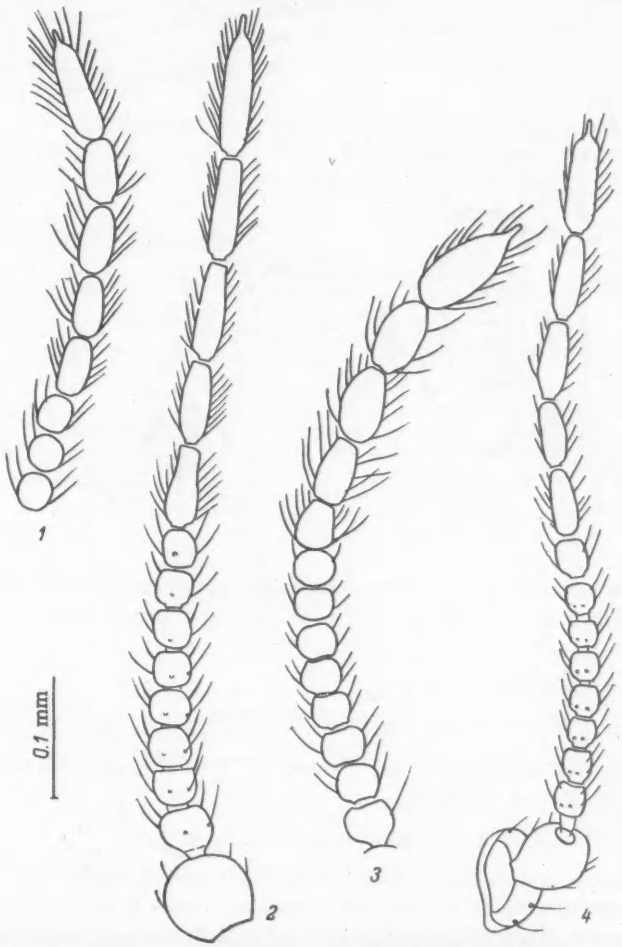
2 (3) Scutellum and humeral areas of scutum yellow. Appendage of the seventh sternite broad, bearing ten finger-like spines at its tip – 3. A. avastensis, sp. n.

3 (2) Scutellum and humeral areas dark.

4 (5) Distal antennal segments long and narrow, segment 14 about three to four times as long as broad. A. R. = =1.5-1.8. Appendage of the seventh sternite narrow, hook-like recurved – 4. A. forcipatus Winn.

5 (4) Distal antennal segments thick, segment 14 about twice as long as broad. A. R. about 1.3.

6 (7) Antennal segment 11 short, a little longer than broad, segment 12 much longer than segment 11. Legs blackish brown. Appendage of the seventh sternite straight, terminating in a comb of eight spines – 2. A. nanus, sp. n.



Figs. 1-4. Antennae of females. 1) Atrichopogon appendiculatus Geot.; 2) A. forcipatus Winn.; 3) A. nanus, sp. n.; 4) A. avastensis, sp. n.

7 (6) Antennal segment 11 almost as long as segmnet 12, about twice, as long as broad. Legs brown. Appendage of the seventh sternite with six spines, partially bent forward or down – 1. A. appendiculatus, Geot.

8 (1) Males.

9 (10) Antennae not plumose, only differing a little from that of the female. Legs blackish brown. Styli with the inner margin serrate – 2. A. nanus, sp. n.

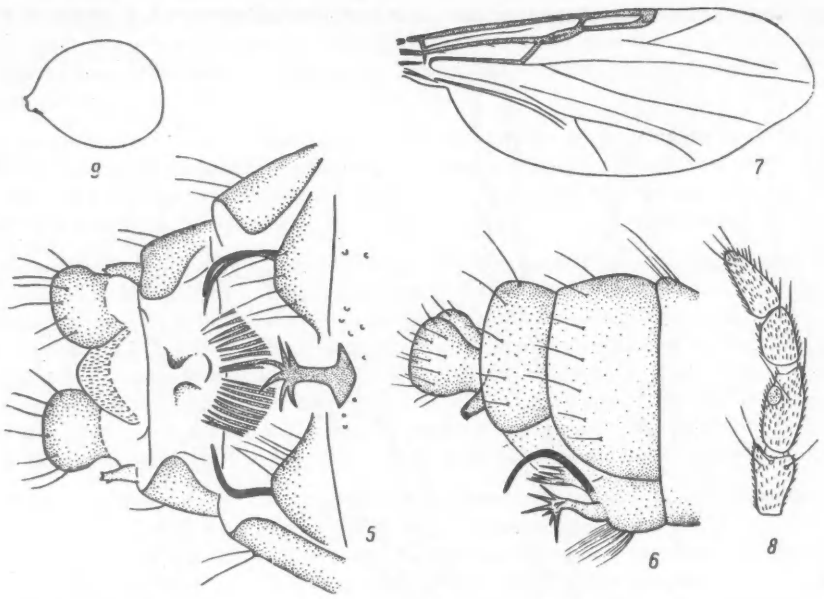
10 (9) Antennae plumose, long setae reaching segment 14 or 15. Styli not serrate.

11 (12) Antennal segment 14 four times as long as broad. Styli broadly excavated in distal half of inner margin, with the tip broad – 4. A. forcipatus Winn.

12 (11) Antennal segment 14, $2\frac{1}{2}$ times as long as broad.

13 (14) Styli deeply excavated in distal fourth of inner margin, with pointed apex. Gonosternum with a prominent crest medially – 1. A. appendiculatus Goet.

14 (13) Styli slightly excavated in distal fouth of inner margin, with rounded tip. Posterior margin of the gonosternum deeply excavated – 3. A. avastensis, sp. n.



Figs. 5-9. Structural details of female Atrichopogon appendiculatus Geot. 5) Apex of abdomen from below; 6) same, in side view; 7) wing; 8) palpus; 9) spermatheca.

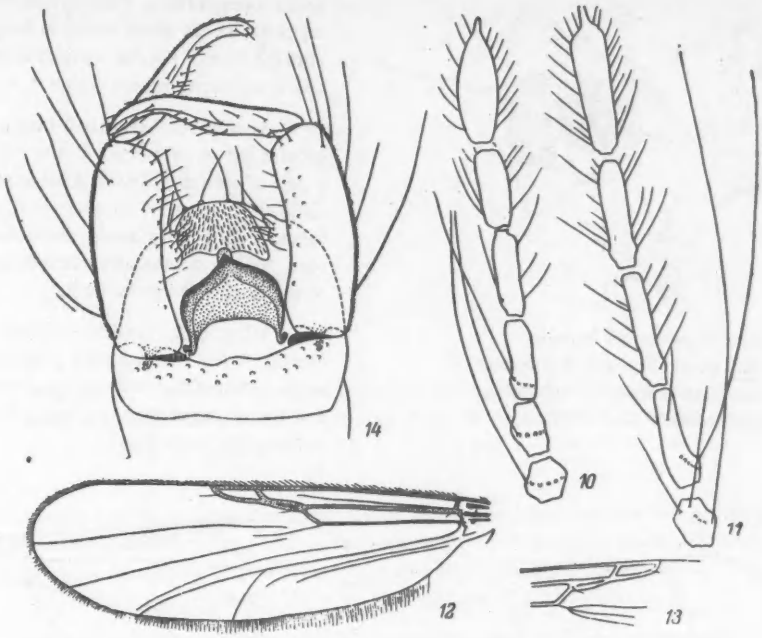
1. Atrichopogon appendiculatus Geot.

Synonyms: adjacens Kieff., ? silesiacus Kieff.

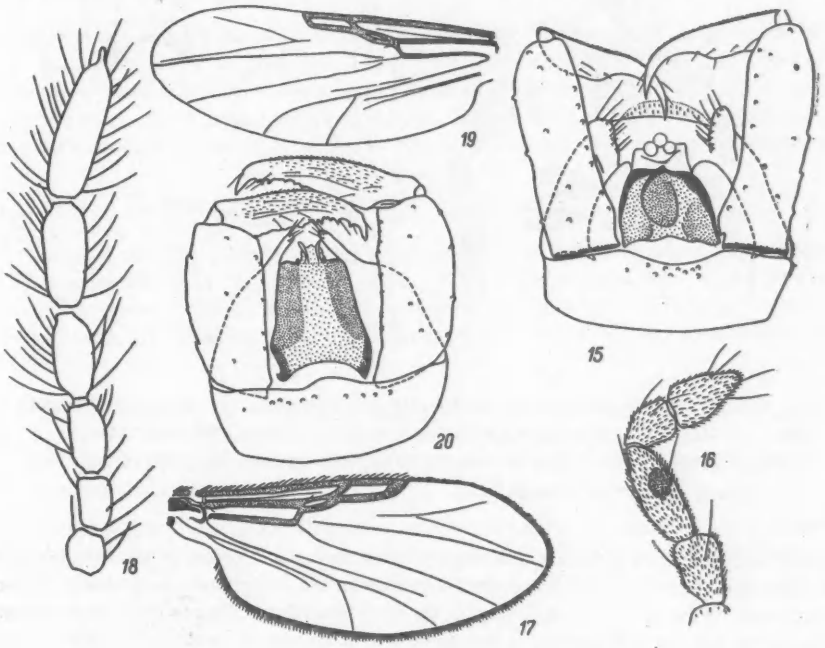
Geotghebuer, 1920: 37, Fig. 23, 24 (Kempia); Kieffer, 1925: 59 (Kempia); Edwards, 1926: 400; Geotghebuer, 1933: 24-25, Taf. III, Fig. 25, Text fig. 22.

Female. Total length 1.5-1.7 mm, length of wing, 1.2-1.3 mm.

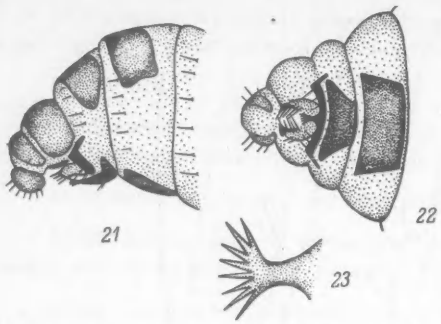
Head, antennae, and palpi dark brown. Beak short, not more than $\frac{2}{3}$ the height of the head, clypeus slightly convex. Eyes entirely pubescent, the setae short on the upper parts of the eyes, scarcely projecting beyond the surface of the ommatidia, longer on the lower part. Palpi (Fig. 8) stout, the third segment not stouter than the rest, short, barely longer then the conical fifth. Proximal segments (3rd to 10th) of the antennae moniliform,



Figs. 10-14. Structural details of amle Atrichopogon appendiculatus Geot. (10, 13) and A. forcipatus Winn. (11, 12, 14). 10 and 11) Apical antennal segments; 12) wing; 13) part of wing; 14) hypopygium.



Figs. 15-20. Hypopygium of Atrichopogon appendiculatus Geot. (15) and structural details of A. nanus, sp. n. 16) Palpus of female; 17) wing of female; 18) apical segments of female antenna; 19) wing of male; 20) hypopygium.

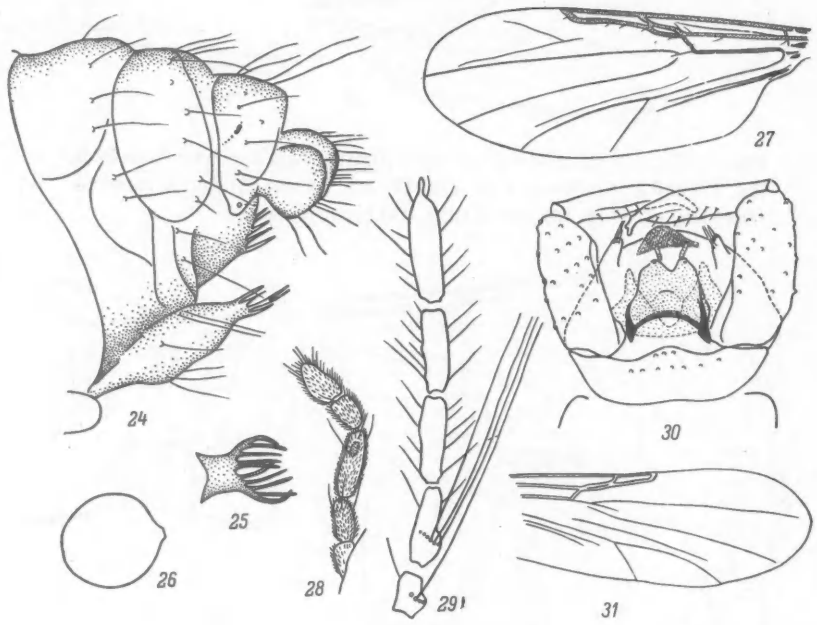


Figs. 21-23. Ventral armature of female Atrichopogon nanus, sp. n. 21) End of abdomen, side view; 22) same from below; 23) appendage of 7th sternite from below.

apical ones (11th to 15th) cylindrical (Fig. 1); segments 11-14 about twice as long as wide, the 15th 3½ times. For the comparative lengths of the apical six segments see Table 1.

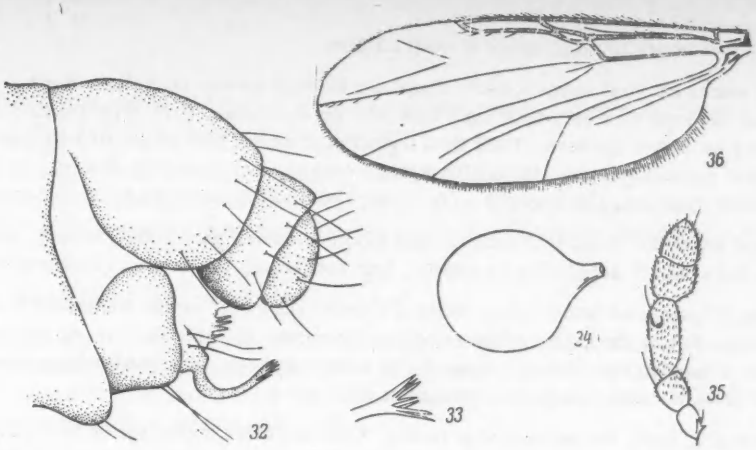
Scutum and scutellum black with delicate greyish brown overtones, feebly shining. Scutum with a pair of subapical black bristles and, next to them, somewhat laterally, an additional pair of short setae. Legs wholly brown, the claws equal and simple. For the comparative lengths of the segments of the hind legs see Table 2.

Wings (Fig. 7) with a whitish tinge, the veins brown. A few macrotrichia present only on radial veins. First radial cell narrow, linear, the second 2-3 times longer than the first. Halteres light yellow, the bases brown.



Figs. 24-31. Strucutral details of Atrichopogon avastensis, sp. n. 24) Apex of female abdomen, side view; 25) appendage of 7th sternite from below; 26) spermatheca; 27) wing of female; 28) palpus of female; 29) apical antennal segments of male; 30) hypopygium; 31) portion of male wing.

Abdomen black with grey overtones, and sparse yellow setae, and stouter yellow bristles along hind edges of posterior segments. Cerci, and eighth and ninth segments yellow in preserved individuals. There is an appendage at the hind edge of the seventh sternite (Fig. 5, 6). The base of the latter is fairly stout, the outgrowths (six in number) at its end are bent forward in dry specimens; in specimens treated with alkali or phenol they are straightened out in various directions and form a star. On either side of the appendage there are one or two heavy bent spines which are considerably longer than the appendage. At the base of each spine there is an eleva-



Figs. 32-36. Structural details of female Atrichopogon forcipatus Winn. 32) Apex of abdomen in side view; 33) appendage of 7th sternite from below; 34) spermathecum; 35) palpus; 36) wing.

tion of the eighth sternite bearing 6-7 stout bristles. Behind the appendage there is a row of stout, straight spines (10-11)in number on each side) which are arranged in a semicircle in front of the reproductive opening. On each side of the hind edge of the 9th segment there is a small appendage with blunt conical teeth at its apex. Spermatheca (Fig. 9) single, oval, measuring 105 × 85 μ (in one specimen), with a short neck.

Male (described for the first time). Coloration and size like those of female. Seta tufts of antennae dark brown, extending to 14th segment. Apical five segments of antennae (Fig. 10) short, segments 12-15 $2\frac{1}{2}$-times as long as wide.

Wings (Fig. 13) with microtrichia, with two normal bristles only on radial vein. First radial cell linear, equal in length to second or a little shorter.

Hypopygium (Fig. 15) dark brown, rather stout, somewhat wider than abdomen, the gonopodites brown. Styli short, about $\frac{2}{3}$ as long as coxite; their inner edge deeply excavated for the distal half. Apex of stylus pointed. Ninth sternite with a shallow excavation medially on the hind margin; bristles situated in a small group before the excavation only. Ninth tergite with long bristles. Gonosternum of complex structure; most characteristic is the presence of a strongly projecting median crest which does not extend to the proximal margin of the gonosternum.

Distribution. Estonian SSR, Transcarpathia; England, Belgium, France, Austria, ? Germany.

Material examined: Estonia: Vyandra district, Viluvere, July 14, 1954, 1 ♀; Tartu district, Vorbuse, June 16, 1955, 1 ♀; Pyl't-sama district, Aidu, August 17, 1954, 1 ♂, 1 ♀; Él'va district, Rannakyula, June 5, 1957, 1 ♀. Transcarpathian region: Svalyav district, Buzhora Mt., August 9, 1956, 6 ♂♂; 1 ♀; Svalyava, August 10, 1956, 17 ♂♂, 8 ♀♀; Bushtinsk district, Velikaya Ugol'ka, August 13-14, 1956, 5 ♂♂, 6 ♀♀; Rakhovsk district, Bogdan, August 18-19, 1956, 3 ♂♂, 8 ♀♀.

A. appendiculatus var. adjacens, described by Kieffer (1924) from France, differs from the nominal form only on the basis of the fact that it possesses two spines external to the appendage of the seventh segment, instead of only one. In our material both instances may be found, sometimes even in the same specimen (Fig. 5), therefore this variety is probably not a separate form.

A. silesiacus Kieffer (1919) was described from Silesia on the basis of the male and is considered by Geotghebuer (1933) as a synonym of A. forcipatus Winn. with a question mark. This form undoubtedly belongs to the subgenus Psilokempia. The original description and especially the accompanying illustration show that this species is most closely related to A. appendiculatus and is probably a synonym of it.

2. Atrichopogon nanus, sp. n.

Small black species with short antennae.

Female. Total length 1,2 mm, length of wing 1.1 mm.

Head and second antennal segment black, flagellum blackish brown. Beak short, equal in length to about $^2/_3$ the height of the head; eyes entirely fringed with delicate short setae. Palpi (Fig. 16) short and stout, barely projecting beyond the end of the beak. Their third segment not stouter than others; its length somewhat shorter than that of apical two segments combined; fifth segment conical. Antennae (Fig. 3) short, the proximal flagellar segments somewhat transverse, 11th segment $1\ ^1/_3$ times, 12th and 13th segmens twice as long as wide.

Scutum and scutellum black, with delicate dark brown overtones, very slightly shining, almost matt. Two pairs of bristles and a pair of lateral setae on scutum. Legs dark brown; for lengths of hind legs see Table 2.

Wings (Fig. 17) with dark brown veins. Veins of anterior edge more or less thickened. Macrotrichia present only on radial veins, one on the lower surface and six on the upper. Radial cells short, the second twice as long as the first. Fork of median vein without a base or with a very short one. Branch of cubitus under the beginning of second radial cell. Halteres pale yellow, their bases dark brown.

Abdomen black, broad, not narrower than thorax. Short and broad appendage on hind margin of seventh sternite (Figs. 21, 22, 23) bearing a comb of 8 teeth. Appendage rests on a strongly sclerotized base. Two broad, pale brown lobes behind appendage, surrounding reproductive opening and bearing apically a group of spine-like bristles. In many dry and preserved specimens the ventral armature is not visible and appears only after treatment in alkali or phenol. Spermatheca single, broadly oval, the neck very short.

Male. Coloration and dimensions like those of female. Eyes entirely with short pubescence. Antennae (Fig. 18) without the usual long setae; several longer setae on basal part of antenna not exceeding 10th segment in length. 11th segment $1\frac{1}{2}$ times, 12th twice as long as wide.

Wings (Fig. 19) not very different from those of female. Both radial cells are long and slender, the second $1\frac{1}{2}$ times longer than the first. Base of median fork rather long.

Hypopygium (Fig. 20) considerably narrower than abdomen, comparatively short. Coxites cylindrical, $2\frac{1}{2}$ times longer than wide. Styli equal to coxites in length, their fairly straight inner margin strongly serrate, the apex sharply tapering and bent inwardly. Ninth sternite not excavated, with a row of setae along hind margin. Ninth tergite short, with short bristles and long slender cerci. Gonosterunm long and trapezoid.

Material examined: Pyarnu-Yagupisk district, Avaste marshes, July 3, 1952, 1 ♀ (Yu. Vil'baste); El'va district Rannakyula, May 28, 1954, 2 ♀♀; Likhulask district, Tukhu marshes, May 28, 1957, 3♂♂, 3 ♀♀.

Holotype (one female, Tukhu) and one male (allotype, same) are in the collection of the Zoological Institute, AN SSSR, in Leningrad; paratypes are in the collection of the department of zoology of Tartu State University.

This species is most closely related to A. parvulus Kieff. (Kieffer, 1919; 25 ♀; Hungary). Common features are the size and coloration of the body, the short apical antennal segments, the short base of the medial vein. Differences are the bare eyes of A. parvulus, its brownish yellow legs, A. R. = 1, and very slender poorly developed radial cell; nothing is mentioned concerning the ventral armature. Although the majority of these differences could be the consequence of the variability of the species or a superficial examination of museum specimens, it seems more expedient to establish a new species, especially as the flight times differ: parvulus from July to August, nanus principally in May.

3. Atrichopogon avastensis, sp. n.

Easily distinguished from all other species of Psilokempia by the yellow markings on the dorsum of the female.

Female. Total length 1.2-1.4 mm, length of wing 1.2 mm.

Head anteriorly yellowish brown, on the clypeus and posteriorly brown. Eyes with short pubescance. Palpi and antennae brown, with delicate yellow setae; apical two palpal segments short (Fig. 28); third segment almost equal in length to fourth and fifth combined, no wider than remainder. Antennae (Fig. 4) slender, the proximal flagellar segments almost moniliform; segments 11-5 cylindrical, $2\frac{1}{2}$-3 times longer than wide.

Scutum black with delicate grey brown overtones, slightly shining, with sparse, pale setae. Scutellum, more or less wide area on the anterior angles of scutum, and two elongated spots before scutellum dark yellow. Basal as well as subapical setae present on scutellum. Legs yellowish brown.

Wings (Fig. 27) pale, the veins brown, macrotrichae present only on radial veins. Second radial cell 2-2½ times longer than first. Halteres yellow, the bases brown.

Abdomen blackish brown, the apical sternites (8 and 9) and ventral appendage yellow. The latter short, broad, with ten finger-like processes atthe apex (Fig. 24, 25). One row of stout spines situated behind the appendage on either side of the reproductive opening. Spermatheca (Fig. 26) single, broadly oval (79 × 74 μ), with a very short neck.

Female. Total length 1 mm, length of wing 1.1 mm.

Blackish brown, the legs yellowish brown. No yellow markings on head or thorax. Scutellum and humeral area sometimes somewhat lighter in color than rest of dorsal surface. Eyes bare. Antennae and their tuft of setae brown, the large second segment black. Apical antennal segments approximately 2½-3 times longer than wide (Fig. 29), their comparative lengths as in Table 1.

First radial cell poorly developed (Fig. 31), linear; lengths of first and second radial cells about equal.

Hypopygium (Fig. 30) small, not wider than abdomen. Coxites short, about 2½ times longer than wide. Styli not shorter than coxites, their inner margin with a slight excavation before the apex; apex subacute. Ninth sternite narrow, projecting medially at hind margin, with two rows of bristles. Gonosternum short, its anterior margin strongly convex, its posterior margin broadly and deeply excavate. A delicate structuresin the form of two nipples (parameres?) on the gonosternum.

Material examined: Estonia: Pyarnu-Yagupisk district, Avaste marsh, July 14-23, 1951, 13 ♀♀, July 6, 1952, 3 ♀♀ (Yu. Vil'baste), July 30, 1952, 2 ♀♀ (Yu. Vil'baste), August 4, 1952, 1 ♀ (Yu.Vil'baste); Pyarnu district, Lake Lavassaare, June 20, 1953, 2 ♀♀; Rapla district, Lake Yarlepa, June 30, 1953, 2 ♀♀; Keila district, Lake Ruil'yar, July 2, 1953, 1 ♀; Khaapsalus district, Lake Khindaste, July 9, 1953, 1 ♀; Valga district, Sangaste, Lake Rabayarv, July 12, 1957, 1 ♂, 2 ♀♀. Leningrad region: Gobzhitsa, Luzh district, June 29, 1934, 1 ♀ (A. A. Shtakel'berg). Transcarpathian region: Svalya district, Buzhora Mt., August 9, 1956, 1 ♀.

The holotype (1 ♀, Lake Lavassaare) is in the collection of the Zoological Institute, AN SSSR, Leningrad. The paratypes are in the collection of the Department of Zoology, Tartu State University.

The species is named after the Avaste marsh, where a large population was first found.

4. Atrichopogon forcipatus Winn.

Synonym: Kempia hamifera Goet.

Winnertz; 1852: 30, Taf. IV, Fig. 21 (Ceratopogon); Schiner, 1864: 590 (Ceratopogon); Lundström, 1910: 36 (Ceratopogon); Lundström, 1916, Fig. 20 (Ceratopogon);Kieffer, 1925 52; Geotghebuer, 1933: 20, Taf. II, Fig. 18.

Geotghebuer, 1920: 38-39, Fig. 25, 26, 27 (Kempia hamifera); Edwards, 1926: 400 (A. hamiferus); Geotghebuer, 1933: 26, Taf. III, Fig. 30, Text Fig. 27 [A. (K.) hamifer]; Zilahi-Sebess, 1940: 37-38.

Female. Total length 1.5 mm, length of wing 1.3 mm.

Head blackish brown, antennae, beak and clypeus brown, the latter strongly convex. Eyes entirely covered with short, indistinct setae which barely project beyond the surfaces of the ommatidia. Palpi (Fig. 35) short, the third segment long, not thickened, equal in length to the fourth and fifth segments combined; the latter short and distinctly wider than third segment. Antennae (Fig. 2) long and slender. Proximal segments of flagellum almost moniliform, the apical ones long, cylindrical, 2½-4 times longer than wide.

Scutum and scutellum black, with delicate grey-brown overtones, slightly shining. Two yellow elongated spots, not seen in dry specimens, in front of scutellum. Scutum with sparse, delicate, dark setae, scutellum with a pair of long subapical bristles and a pair of short basal setae. Legs pale brown.

Wings (Fig. 36) with macrotrichia on radial veins and distal third of first medial vein, rarely also in the apical cells (R_5, M_1). Veins fine, fuscous. Radial cells well developed, the second 2½-3 times longer than first.

Halteres white, the bases brown.

Abdomen blackish brown, cerci brown. Between the 7th and 8th sternite there is a slender, posteriorly bent appendage (Fig. 32, 33) with a cluster of five to ten spines at the end. Behind the appendage, on either side,

of the reproductive opening, there are 10-12 long spines. These rows of spines are approximated for their median portions. Spermatheca single (Fig. 34), oval, with a fairly long, gradually narrowing neck. Its dimensions are 80 × 70 μ, length of neck 20 μ, its width at the end 6 μ.

Male. Total length 1.5-1.75 mm, length of wing 1.4 mm.

Coloration as in female, no yellow spots on scutum. Eyes with short setae above, sometimes entirely bare. Palpi as in female, the apical segments narrower. Antennae (Fig. 11) long, its apical segments 4-5 times longer than wide. Tuft of setae blackish brown, with gold reflections, extending almost to apex of antennae.

Wings (Fig. 12) with short radial cells, the first narrow, the second fairly wide, equal in length to the first.

Hypopygium (Fig. 14) large, wider than abdomen; gonopodites yellow. Coxites more than three times as long as wide; stylus slightly shorter than coxite. Inner margin of stylus sinuately curved out, the apex somewhat narrowed. Ninth sternite with numerous bristles on distal half, strongly sclerotized before base of coxite. Gonosternum strongly convex, narrowed apically, with a short, weakly sclerotized appendage.

Distribution: Karelian SSR, Leningrad region, Estonian SSR, England, Belgium, Germany, Austria, Hungary, Finland.

Material examined: Estonia: Pyarnu-Yagupsk district, Avaste marsh, June 4- July 30, 1952, 15 ♂♂, 40 ♀♀ (Yu. Vil'vaste); Iykhvis district, Radid, Kurtna, June 7-8, 1953, 1 ♂, 3 ♀♀; Kiviylis district, Ul'yaste, June 9, 1953, 1 ♂; Pyl'tsmaa district, Lake Parika, June 18, 1953, 9 ♂♂; Viabla, July 1, 1957, 9 ♀♀; Pyarnu district; Lake Lavassaare, June 20, 1953, 3 ♂♂, 2 ♀♀; Likhula district, Kyaomardi Bay, June 24, 1953, 2 ♀♀; Pukhtu, June 25, 1953, 1 ♂, 3 ♀♀; Rapla district, Lake Loosalu, June 28-29, 1953, 2 ♂♂, 21 ♀♀, Lelle, June 29, 1953, 1 ♀, Lake Yarlepa, June 30-July 1, 1953, 5 ♂♂, 33 ♀♀; Khaapsalus district, July 9, 1953, Lake Khindaste, 1 ♀, Lake Tyanav"-yarv, 1 ♀; Keila district, Rayon, Loooga, July 10, 1953, 5 ♀♀; Tartu district, Lake Leegu, July 28, 1953, 1 ♀, Vorbuse, June 30, 1954, 3 ♂♂, 1 ♀; Vil'yandis district, Val'ma, June 19, 1954, 2 ♀♀; Él'va district, Rannakyula, June 17, 1956, 2 ♀♀; July 2, 1957, 1 ♀, Voore, June 29, 1957, 6 ♂♂, 4 ♀♀; Tyrva district, Pikasilla, June 29, 1956, 2 ♂♂, 8 ♀♀; Valga district, Sangaste, July 11, 1956, 1 ♂; July 12, 1957, 5 ♂♂, 5 ♀♀.

A. hamifer Goet. and A. forcipatus Winn. are distinguished, according to Kieffer (1925) and Geotghebuer (1933), by the pubescence of the eyes and were consequently separated into different genera (or subgenera). As indicated above, this character has no systematic value and without doubt these two species are consequently identical.

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NEW LEAF MINERS (DIPTERA, AGROMYZIDAE) OF THE USSR FAUNA

E. B. Rodendorf-Golmanova

1. A NEW PEST OF OLEASTER

In summer 1953 N. A. Mazurkevich, who worked in the Moscow State University Entomological Section in the Combined Expedition on Shelterbelt Afforestation, bred out some flies, the larvae of which mined the leaves of oleaster. The leaf miners were found in Tinguta Forestry in Stalingrad region. An examination showed that this species belonged to the genus Phytobia Lioy (= Dizygomyza Hendel) and the subgenus Praspedomyza Hendel; it was difficult, however, to identify the species: It was unknown, and the plant itself has never yet been indicated as a food plant of agromyzid larvae.

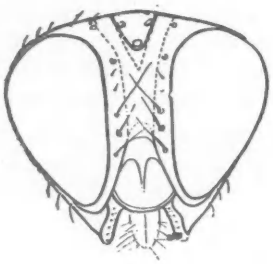

Fig. 1. Phytobia (Praspedomyza) elaeagni E. Rohd.-Holm., sp. n. Head of female, dorsal aspect.

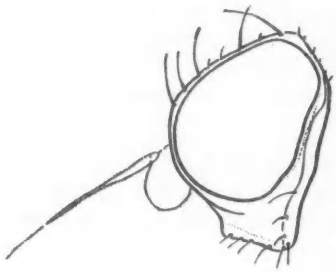

Fig. 2. Phytobia (Praspedomyza) elaeagni E. Rohd.-Holm., sp. n. Head of female, lateral aspect.

Phytobia (Praspedomyza) Elaeagni E. Rohdendorf-Holmanova, sp. n.

Head (Figs. 1 and 2). Width of frons behind equal to distance from anterior ocellus to lunule, which is semicircular. Vertical plates in the form of stripes which broaden slightly level with lunule. Jowls in hind part in profile less than half and more than one-third eye height. Cheeks projecting slightly, not visible at all in male in profile. Thorax. ac very variable in number, from an indistinct two-row series to a prominent five-row series extending back to second pair of dc; dc 1 + 3 in number. Wing (Fig. 3). Costal vein, as in Ph. approximata Hendel, reaching end of M_{1+2} at apex of wing. Second intersect of C 2½ times longer than third. The distance between cross vein tp and rm is greater then length of tp. Color. Frons and lunule dark yellow to rufous, vertical plates from vertex to ors brown, jowls pale yellow. Face dirty yellow, darkened, margin of mouth pale yellow, palps black, proboscis yellow. Head black behind. Thorax and scutellum matt, dusted with grey, as distinct from glossy luster in Ph. approximata Hendel and Ph. monfalconensis Strobl. Thoracic pleura yellowish near notopleural suture and wing base. Wings transparent, veins pale brown. Thoracic squamae with dark brown hairs. Legs and abdomen black, apices of fore tibiae yellow. Body length 1¾-2 mm.

Material: 3 males and 3 females, preserved in the collection of the Entomology Department of Moscow University.

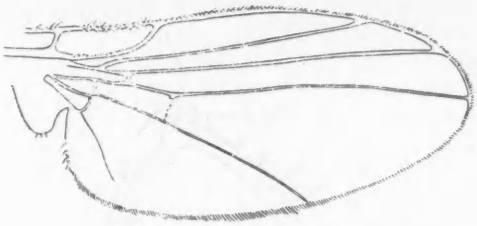

Fig. 3. Phytobia (Praspedomyza) elaeagni E. Rohd.-Holm., sp. n. Wing.

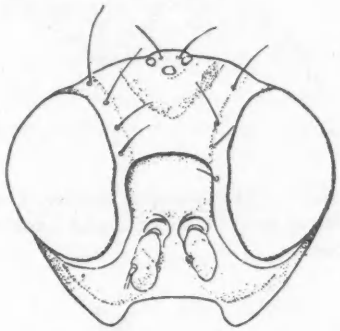

Fig. 5. Melanagromyza kirgizica E. Rohd.-Holm., sp. n. Head of female, frontal aspect.

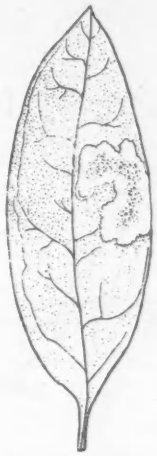

Fig. 4. Oleaster leaf with mine of Phytobia elaeagni E. Rohd.-Holm., sp. n. (Natural size).

Ecology. The larvae mine the leaves of oleaster (Elaeagnus angustifolia L.). The mines are on the upper-side (Fig. 4), in the form of cloudy vesicles, white at the edges, green inside, with small and larger scattered particles of excrement forming a broad path in the center of the mine. The exit opening of the mine is in the form of a long horseshoe near the midrib of the leaf. Mining occurs in June, pupation in the last week of June. The puparium is found outside the leaf, in the soil. The imagos emerge during the first ten days of July.

I sent the types of this species to Prof. Dr. E. M. Hering (Berlin, DDR), who informed me that this species was very distinctive and possessed a mixture of characters of two subgenera – Praspedomyza and Trilobomyza. This transitional character of our species makes it advisable to supplement the keys to these two subgenera. These additions to the keys were very kindly made by Prof. Hering and I express my thanks to him for this. I give a translation of Hering's additions.

HENDEL'S KEY (HENDEL, 1931: 19)

(After Hering)

–(Subgenus Praspedomyza Hend.) – 14.

14. – Third segment of antenna yellow to dark brown. Joints between fore femora and tibiae yellow to reddish – 14a.

– Third segment of antenna black. Joints between fore femora and tibiae not yellow – 15..

14a. Frontal stripe entirely pale brown. Thoracic dorsum entirely shining black, with no trace of grey bloom. 5 - 6 rows of acrostichal bristles – morio Brischke.

– Fore part of frontal stripe, and also cheeks, jowls and face pale yellow. Thoracic dorsum with bluish grey bloom concealing luster. 3 - 4 rows of acrostichal bristles – elaeagni Rohd.-Holm.

–(Subgenus Trilobomyza Hend.) – 16.

16. Anterior ors situated behind midpoint between vti and base of antennae – 17.

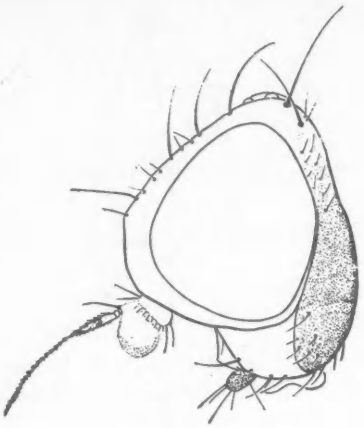

Fig. 6. Melanagromyza kirgizica E. Rohd.-Holm. sp. n. Head of male, lateral aspect.

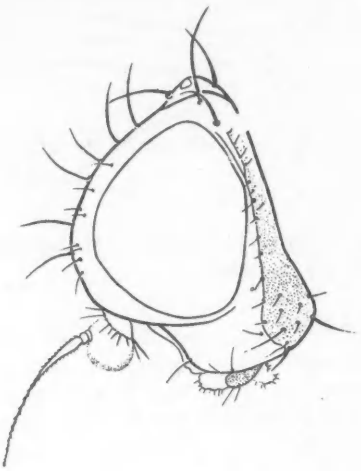

Fig. 7. Malanagromyza kirgizica E. Rohd.-Holm., sp. n. Head of female, lateral aspect.

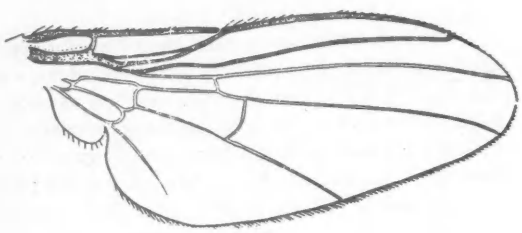

Fig. 8. Melanagromyza kirgizica E. Rohd.-Holm., sp. n. Wing.

Fig. 9. Melanagromyza kirgizica E. Rohd.-Holm., sp. n. Cephalopharyngeal skeleton of third-instar larva.

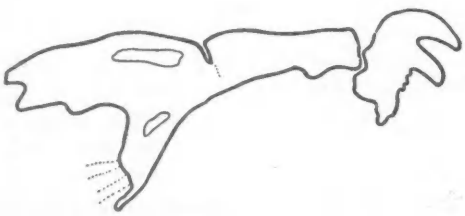

Fig. 10. Melanagromyza kirgizica E. Rohd.-Holm., sp. n. Damaged twig of ivy (Natural size).

Fig. 11. Melanagromyza kirgizica E. Rohd.-Holm., sp. n. Anterior of third-instar larva.

Fig. 12. Melanagromyza kirgizica E. Rohd.-Holm., sp. n. Posterior spiracles of third-instar larva.

Anterior ors situated in front of midpoint between vti and base of antennae – 16a.

16a. tp located level with junction of R_1 and C. Last intersect of m_4 2½ times longer than second to last. Bases of wing veins contrastingly pale lemon yellow. Upper and hind margin of mesopleura pale yellow – labiatarum Hend.

– tp located distad of junction of R_1 and C. Last intersect of M_4 only a little longer than twice second to last. Veins entirely yellow-brown, only slightly paler at base of wing. Mesopleura without pale yellow margins – elaeagni Rohd.-Holm., sp. n.

2. A NEW STEM PEST FROM KIRGIZIA

K. Ibraimova passed on to me damaged portions of plants and insects injurious to willows in the Issyk-Kul region of the Kirgizian SSR. When this material was identified it was found that the galls on the willow branches were caused by larvae of a leaf mining fly belonging to a new species of the genus Melanagromyza Hendel of the family Agromyzidae.

We give a description of this species.

Melanogromyza kirgizica E. Rohdendorf-Holmanova, sp. n. (Figs. 5-12)

It is easily distinguished from all the species known to me by the costal vein, which extends to the fifth radial, and by the small number of scattered orbital bristles with forward-pointing apices.

Head. Frons broader than long; height of lunule equal to three quarters of the distance from its hind margin to the anterior ocellus, (Fig. 5). Vertical plates protruding, of same width as tibiae. Ocellar triangle equilateral 1 ori + 3 ors in males and 2 ori + 4 ors in females. Orbital bristles 6-8 in number, situated irregularly (in one or two rows) and with apices directed forward. Frons and cheeks in profile projecting a distance almost equal to half height of jowls (Figs. 6 and 7). Height of jowls equal to ⅓ eye height. Face smooth, without keel, with slight luster. Epistoma projecting more in male (Fig. 6). Color. Frons, lunule and vertical triangle black, matt with slight luster; vertical plates more lustrous. Jowls bronze-brown, velvety, with slight luster: occiput and venter of jowls blackish brown, lustrous. Proboscis dark yellow. Thorax black, more lustrous at sides. dc 0 + 2; acr 8 - 10 rows, reaching to first dc. Scutellum black, matt. Wing (Fig. 8). Apex of wing lies between R_5 and M_{1+2}. Costal vein barely reaching R_5, tapering away; distance of tp from rm less than length of tp. Last intersect of M_{1+2} larger than second last. Postalar plates dirty white with black hairs. Legs shining black; tarsi dark brown. Abdomen black, shining; length of sixth tergite twice that of fifth, sixth tergite with fine orange rim. Body length 3.5 mm, wings 3 mm.

The larvae produce galls on the branches of the willow Salix niedzweckii Gorz. and another, still unidentified, shrub species of willow (Fig. 9). Pupation takes place in the gall, the hind end of the puparium sticking out of the gall. The injuries sustained, according to K. Ibraimova, lead to the complete drying up of all the branches of the shrub.

The white larvae, 5 - 7 mm long, 2 mm broad, have prominent simple eye and mouth hooks. The cephalopharyngeal skeleton (Fig. 10) consists of large unpaired mouth hooks with two teeth and a large base. The hypostomal and pharyngeal sclerites are weakly developed in comparison with the mouth hooks. The anterior spiracles (Fig. 11) are mushroom-shaped, on stout stalks, with an undetermined number of pits and a structure very difficult to make out under magnification 6 x 100. Posterior spiracles (Fig. 12) of same size as anterior, and also with an indeterminate number of openings, of which approximately 8 or 9 are distinctly kidney-shaped.

Material: 27 ♂♂ and ♀♀, bred out from mines which K. Ibraimova collected on branches of Salix niedzweckii Gorz. in Balykcha district of the Issyk-Kul region of the Kirgizian SSR; the imagos emerged on June 13 - 16, 1955.

This species is distinctive and in structure most resembles Melanagromyza aeneiventris Fln. In mode of life it is like M. schineri Girault, which also forms galls and damages willows and poplars in Europe and North America.

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CURRENT EVENTS

ON THE 75TH BIRTHDAY OF PROFESSOR S. G. LEPNEVA

L. A. Zhil'tsova

On April 15, 1958, Professor Sof'ya Grigor'evna Lepneva, Doctor of Biological Sciences, head of the Neuroptera section at ZIN AN SSSR, attained the age of 75.

Sof'ya Grigor'evna was born on April 15, 1883 in Voronezh of a family of teachers. In 1901 she graduated from the gymnasium at Voronezh and enrolled in the Upper Women's Courses in Moscow, which she completed in 1906 with a major in the zoology of invertebrates; at that time such prominent zoologists as Menzbir, Sushkin, and Kol'tsov were teaching.

From 1907 to 1918 she taught natural history and geography in middle schools. In 1911 she transferred to Yaroslavl, where she was elected a member of the Yaroslavl Natural History Society. From 1913 to 1917 she was the science secretary of that society. In Yaroslavl in 1914 S. G. also began scientific work as organizer and active participant in investigations undertaken by the Yaroslavl Natural History Society. The result of this work was her first publication "Essays on the life of fresh waters" (1916), which received wide distribution and recognition, and also a series of papers on the biology of fresh waters (1921) and a comprehensive work on "Biological investigations of the Kotorosl' River in the region of Yaroslavl" (1922).

Simultaneously with her teaching in the gymnasium, she taught biology and zoology in Yaroslavl Teachers' College from 1916 to 1918. In 1918 she moved to Voronezh, where she lectured in the Government Department for People's Education and taught zoology in the People's University of the October Revolution. In 1919 and 1920 she taught zoology in Voronezh Pedagogical Institute; the summer of 1920 she work in the Volga Biological Station at Saratov. In 1920 S. G. returned to Yaroslavl and took over the position of head of the department of zoology at Yaroslavl Pedagogical Institute, at the same time continuing to work in the Yaroslavl Natural History Society as science associate and head of the Society museum. From 1921 on she worked during the summer months in the State Hydrobiological Institute in Leningrad.

In 1922 Sof'ya Grigor'evna moved to Leningrad and was elected associate at the State Hydrological Institute, where as part of the Olonets Scientific Expedition she spent time investigating the lakes of Karelia. She completed a study of the littoral fauna of Segozero in 1921, a study of the sublittoral and profundal zones of Vygozero in 1922, and a complex limnological investigation of the lakes of the Vygo-Onezhkii watershed in 1923, also determining all the larval caddis fly material of the Olonets Expedition; from that time on this group became the subject of specialized study by her. As a result of the work in Karelia there appeared several notes and a comprehensive ecological and faunistic paper devoted to the caddis flies of the Olonets Krai (1928). In this work the caddis flies are examined on the background of the comparative limnological features of the lakes and their peculiarities. At the completion of her work with the Olonets Scientific Expedition, she worked in the hydrobiological and lacustrine sections of the State Hydrological Institute.

In 1925 she was sent to Novosibirsk where she undertook public health biological investigations of the river Ob' and its tributary the Inya, being to a large extent instrumental in the correct selection of a location for placing the intake of the city water conduit. The work published in 1930 which described in detail the bottom fauna of the upper Ob' is the first detailed characterization for Siberia of the bottom fauna of one of its greatest rivers.

From 1925 to 1929 she processed a great deal of material on caddis fly larvae, publishing a series of papers devoted to the caddis worms of the Oka, Kama, the Middle Volga, the Meshcherskaya depression of the North Don and Dnepr, and giving a talk at the Third All-Union Session of Zoologists, Anatomists, and Histologists on the comparative ecology of caddis worms.

From 1928 to 1934 she led an expedition for the intensive investigation of the limnology of Lake Teletskoe in the Altai. The results of analysis of the comprehensive data collected by her personally and by her associates were published in four reports. In these she published a series of major works shedding light on the life and environmental conditions of this extremely deep body of water in the Altai. These investigations placed this lake, which had been until then poorly studied, among those most thoroughly investigated. The work "Bottom fauna of Lake Teletskoe and its conditions of existence" was successfully defended by her in 1945 as a doctoral dissertation.

In 1936 she transferred to the Zoological Institute, AN SSSR, and after the departure to Moscow of A. V. Martynov she acquired from him management of the Neuroptera Section. From that time on S. G. devoted a great deal of attention to the systematics and morphology of the larvae of caddis flies.

Sof'ya Grigor'evna is not only a first-class investigator, stating and solving major scientific problems, but also an excellent field worker and organizer. As associate in the Zoological Institue she continued her field work in the study of caddis flies, working in western Siberia in 1937, in the region of Seliger Lake in 1939, and in the environs of Borodino Biological Station (in southern Karelia) in 1940. In 1942 she was evacuated to Stalingrad together with the entire Zoological Institute personnel. In the summer of 1943 in Tadzhikistan she carried out investigations on the biotopes of the malaria mosquito,and in 1944 studied caddis fly larvae in various places in the Gissar Range. After returning to Leningrad she carried out field work in the Kalinin district around the "Zaluch'e" biological station (1946 – 1951) and in Transcaucasia (1948). An expeditionary trip to the Barzhomskii district of the Georgian SSR in 1953, in which the author of the present article was able to take part, was accomplished by S. G. at the age of 70. Very interesting material was collected during this excursion.

At the present time she is working intensively toward the completion of the second volume of her fundamental work "Manual of the caddis fly larvae of the USSR" (the first volume now being ready for press). This work comprises the sum total of all of the author's previous works. After 45 years of scientific activity she has published more than 80 works, which have brought her wide reknown. In addition, she has published a series of popular scientific works. She composed three chapters of the first volume of "The Life of Fresh Waters of the USSR" (1940); "Life in Lakes", a valuable contribution to the world literature on lake management, is the first account in our literature which reflects the results of biological investigations in the lakes of all regions of our country and was published as the third volume of the same series (1950); she wrote the chapters on caddis flies in volumes IV and V of "Terrestrial Animals of the USSR."

All of her works on the systematics of caddis flies are a valuable contribution to the literature on Trichoptera, laying down a firm and broad foundation for the systematic study of this important group. These works introduced into the study of this group the newest methods of morphological-systematic analysis; some of these enabled her to base the taxonomy of the group upon new, exact data.

One of the major limnologists and hydrobiologists of the Soviet Union, widely known here and outside the USSR, a major specialist on the order of caddis flies, and talented teacher, Sof'ya Grigor'evna enjoys great authority and affection among her colleagues and students. As a talented teacher and elder comrade, always ready to help with her broad knowledge and experience,Sof'ya Grigor'evna is constantly surrounded by youth; her work in this connection far exceeds the bounds of the institute. Sof'ya Grigor'evna is the untiring organizer and manager of the complex Neuroptera Section, comprising 16 orders of insects. From 1951 to 1958 Sof'ya Grigor'evna led the science seminar which she organized in the Entomology Section of the Zoological Institute.

For her scientific and social activities over many years Sof'ya Grigor'evna was awarded the Order of Lenin, Badge of Honor, and medals, as well as a diploma from the Supreme Soviet of the Tadzhik SSR, and was elected honorary member of the All-Union Entomological Society.

ON THE 75TH BIRTHDAY OF V. V. NIKOL'SKII

N. O. Olenev

Vyacheslav Vsevolodovich Nikol'skii is one of the senior entomologists of the USSR. He has undertaken investigations, organized control measures, and fulfilled government assignments on plant protection and the preservation of vegetation from foreign agricultural pests, spending much time on the elaboration of a vacuum fumigation method for disinfecting imported cotton seed.

His scientific works (he has published about 40) are devoted to the Asiatic locust and methods for controlling locusts, to cotton pests (Gelechia malvella Hb., Pyroderces rileyi Wals., Chloridea obsoleta F., and Earias inculana Boisd.), the Colorado potato beetle, spider mites, and to problems of quarantine and medical entomology.

V. V. Nikol'skii was born on February 13, 1884, in Tashkent. He graduated from Petersburg University in 1913 in the Natural Sciences. He worked in entomology under I. A. Porchinskii and M. N. Rimskii-Korsakov. He worked in CentralAsia, the Caucasus, and in the central institutions of Moscow and Leningrad. In 1928 he was director of the Cotton Pests and Diseases Control Station in Tashkent and head of its Entomology Section. From 1931 to 1939 he headed the Quarantine Sector, and then the Cotton Sector, of the All-Union Institute of Plant Protection. In 1936 he was approved for an academic degree as candidate in agricultural sciences without defending a dissertation. During the Great Patriotic War and the postwar period until 1949 he worked in Azerbaidzhan as head of the entomology section of the research institute in Kirovabad. From 1949 to 1956 he worked in the Leningrad Quarantine Laboratory of "Gosinspektsiya".

V. V. Nikol'skii was repeatedly sent on assignments to various countries of Europe and America on problems of plant protection and quarantine. He took part in 1928 in the International Entomological Congress in the USA.

We wish Vyacheslav Vsevolodovich health and many years of life and work for his nation.

ON THE 60TH BIRTHDAY OF PROFESSOR L. P. KALANDADZE

G. Ya. Bei-Bienko

On February 28 of the current year Professor Leonid Polievktovich Kalandadze, eminent entomologist and zoologist, active member of the Academy of Agricultural Sciences of the Georgian SSR, and honored scientist of the Georgian SSR, marked his 60th birthday.

Participating in the celebration in his honor were many biological and agricultural research and production institutions, higher academic institutions in the USSR and Georgia, and also the All-Union Entomological Society and its Georgian branch.

He was born on November 17, 1898, of a literary family. When still a student, in 1920, he began working in the Bureau of Pest Control as an instructor and from that time on plant protection was the basic field of his scientific, social, and practical activities. However, the sphere of L. P. Kalandadze's scientific interests is not limited to agricultural entomology alone – he also works in forest and medical entomology. During his scientific activity he has published more than 100 works, texts for higher educational institutes, and several popular scientific works.

Also of great importance are his teaching activities as a professor in a higher education institution and advisor of numerous students.

Distinguished by a lively and active nature, he is doing a great deal of scientific and social work and is closely associated with practical institutions and organizations carrying out control measures against agricultural

and forest pests and in the field of public health. For many years he has been the permanent chairman of the Georgian branch of the All-Union Entomological Society, stimulating and coordinating the activities of entomologists in the Georgian SSR.

The entire scientific, scientific-social, and teaching activities of L. P. and his students has promoted the successful development of entomological research and service in the Georgian SSR. Several of his scientific works are of significance for the entire Transcaucasus and the Soviet Union as a whole.

At the 60th anniversary of L. P. and in recognition of his scientific and social merit the All-Union Entomological Society elected him an honorary member.

We wish Professor L. P. Kalandadze long years of even more energetic and productive activity in the field of entomology.

ON THE 60TH BIRTHDAY OF PROFESSOR S. I. MEDVEDEV

D. S. Shapiro

In a ceremonial session Khar'kov State University marked the 60th birthday of Professor Sergei Ivanovich Medvedev, Doctor of Biological Sciences and head of the entomology department of the university.

S. I. was born January 16, 1899 in Khar'kov into a family of agronomists. After termination of practical schooling S. I. enrolled in the Natural Sciences section of Khar'kov University, completing his studies in 1920; thereafter he worked on entomology in various research institutes in the country.

S. I. is one of the major native experts in the field of faunistics, systematics, ecology, and zoogeography of insects; his works are well known both at home and abroad. More than 110 works were written by him among which many major monographs were published by the Zoological Institute of the Academy of Sciences of the USSR in the "Fauna SSSR" series. In his theoretical works he has discussed a number of valuable ideas concerning the problems of the origin of the insect fauna in the different territories of the Soviet Union and, particular, the formation of the insect fauna of the forest-steppe and steppe zones of the Ukrainian SSR, giving prognoses of distribution conditions for important agricultural and forest pests in various regions.

The works of S. I. on the natural formation of the entomofauna of the USSR are notable for their depth of thought and practical significance. This sort of investigation is represented by such works as "Problems in the ecological, faunistic, and zoogeographic divisions of insects", "Fundamental factors in the modification of the Ukrainian entomofauna in relation to the formation of culture zones", "Influence of human activities on the entomofauna", and many others.

S. I. Medvedev's works are very important in relation to the practise of socialist agriculture and forestry: he is the author or coauthor of a whole series of manuals for the determination of insects which are widely employed in entomology in the Soviet Union and other countries and also used by students in agriculture schools and faculties of biology departments in universities. Several of S. I.'s works are devoted to the study of serious pests and contain, together with descriptions of biology and ecology, recommendations for effective control measures To this category belong works on pests of sugar beet and tree-shelter plantings; he has devoted much attention to control measures in his published monographs on the scarab beetles.

As a teacher, he enjoys much affection and esteem among students.

S. I. has formed a large grouping of specialists working in various higher education and research institutes in the USSR. Among his students S. I. can count professors, assistant professors, and science workers.

S. I. Medvedev is an exceptionally modest man and sympathetic comrade, always ready to help with advice and to share knowledge.

At his 60th birthday S. I. Medvedev was elected honorary member of the All-Union Entomological Society.

ON THE 60TH BIRTHDAY OF PROFESSOR V. N. STARK

V. M. Berezina

On January 1, 1959, Professor Vladimir Nikolaevich Stark, Doctor of agricultural sciences, head of the Laboratory for the Study of Forest and Tree-Shelter Pests of the All-Union Institute of Plant Protection of VASKhNIL, completed 60 years of life and 40 years of scientific, teaching, and social activity.

The name of the celebrant as one of the most important forest entomologists is widely known both in our country and beyond its borders.

A natural biologist with boundless love for the forest, delving deeply into its life, he has devoted and continues to devote his entire working like to the study of its inhabitants – the insects. He has participated most actively and unceasingly in investigations, led the working group in the laboratory, and for the past ten years has been the permanent chairman of the Section on Forest Protection in the annual All-Union planning and coordinating conference on problems of plant protection.

A characteristic feature of the celebrant is a most felicitous combination of abilities to work out profound theoretical problems, and also to resolve economically important tasks, a combination most clearly apparent in a series of works on bark beetles and in papers devoted to entomological problems connected with tree-shelter cultivations.

Of his published works, among the most important and widely known are the following: "Forest insect pests" (1931), "Manual for the evaluation of forest damage" (1st ed. 1930, 2nd ed. 1932), and a monograph on "Bark Bettles" which appeared in the "Fauna USSR" series (1952). We must also mention the numerous (more than 100) papers written by the celebrant which are always distinguished by the profundity of their content, the originality of the matters raised, and the progessiveness of the ideas set forth.

Among the greatest accomplishments of the celebrant is an entomological collection which he has uninteruptedly compiled since his youth, primarily in the Coleoptera, the most important results of which are represented by a unique collection of Palaearctic bark beetles, donated by him to the Zoological Institute, AN SSSR, and by a no less complete collection of weevils of the genus Apion.

He has also devoted much attention and effort during his 40 years of activity to the preparation of cadres of young specialists during his earlier years as teacher at the Karachizhko-Krylovskii Forest Technical School, then as professor of forest entomology at IZIF, and finally as advisor to numerous student groups in VIZR. The majority of his students are now not only already independent, but even rather well-known specialists. All of these remember their teacher with the warmest feeling and deepest gratitude as a man of the highest mental calibre, a talented teacher, and scholar of broad erudition. A clear demonstration of this is provided by the great number of telegrams and salutations received at his address on February 2, 1959. On this day a special session of the Scientific Council of VIZR was held in honor of Vladimir Nikolaevich Stark. Representatives of many research institutes, scientific societies, and other organizations attended the ceremonial session, heartily congratulating the celebrant and sincerely wishing him health, good fortune, and even more success in future life.

At his 60th birthday V. N. Stark was elected an honorary member of the All-Union Entomological Society. V. N. Stark was awarded the Order of Lenin.

THE SECOND CONFERENCE ON INSECT PATHOLOGY OF THE INTERNATIONAL COMMITTEE FOR BIOLOGICAL CONTROL

I. A. Rubtsov

The second conference on insect pathology organized by the International Committee for Biological Control (C.I.L.B.) took place on October 22–25, 1958, in Paris. Microbiologists and entomologists from France, the Federal Republic of Germany (FRG), the German Democratic Republic (GDR), Czechoslovakia, Yugoslavia, Spain, and other countries, 25 delegates in all, took part in the conference.

The session lasted three days. During the first two days the conference worked in the Zootechnical Station (in the neighborhood of La Minière, near Versailles, where there is also an entomological laboratory under Prof. Trouvellot) and during the last day at the Pasteur Institute. On the fourth day an excursion was organized into the forest reserve of Fontainbleau, where there is a station of the Forest Institute.

The papers presented during the first day of the conference were devoted to bacterial, rickettsial, fungal, and protozoan diseases of insects. On the second day the conference primarily touched upon virus diseases of insects. The third day was devoted to the problems of ecology and the practical utilization of entomophages for the control of pests. A total of about 30 papers was presented (each five to fifteen minutes long) with short debates after each paper.

The first papers touched upon the general question of intraspecific variability and strains of pathogenic microorganisms. A. Bonnefoi and S. Beguin (Pasteur Institute), in the introductory talk, announced that young, spore-free cultures of the "Anduze" strain of Bacillus thuringiensis are not harmful to insects. From the beginning of spore formation these same bacteria become pathogenic to insects (to the cabbage butterfly). Special experiments led the authors to the conclusion that the toxicity of B. thuringiensis during the spore formation stage is related to the appearance of crystalline protein inclusions.

Bonnefoi and M. Toucas (Pasteur Institute) investigated the thermal stability of May beetle milky disease pathogens. The lethal temperature for the pathogenic bacteria (in suspension and in distilled water) is between 84° and 90°C. Under sublethal temperatures (around 84°C) the virulence of the disease pathogen for the May beetle is greatly reduced.

A paper by A. Burgerjon (Biological Control Laboratory at La Minière) discussed how to determine a pathogenic dosage of a preparation of a given strain of B. thuringiensis. By means of accurately weighing and measuring small dosages of the dry preparation from spores and in suspension the author determined the biologically effective unit and introduced a method of estimation which enables the number of effective biological units in 1 gm of microbiological preparation to be determined.

Irina Van'kova (Biological Institute in Prague) discussed her investigations on B. thuringiensis in Czechoslovakia. She had isolated a new strain of this microorganism from caterpillars of Plodia interpunctella and established the optimal conditions for the large-scale culture of this strain. She also discovered that the pathogenic nature of the strains is especially clearly revealed during the spore formation stage, and is connected with the appearance of crystalline bodies, usually on the fifth or sixth day of culturing. It was shown by laboratory experiments that good ventilation facilitates the culture of microorganisms. Under laboratory conditions spore formation lasted about 48 hours on the average. Containers of about 200 liter capacity were the most suitable for massive spore production. Spore masses and crystalline inclusions were isolated by means of centrifugation followed by desiccation. The preparation thus obtained was tried against the cabbage worm. After treatment of the experimental plot almost total mortality of the caterpillars was observed after 10 days. Spores of B. thuringiensis appeared in the treated plot as early as a month after treatment under favorable weather conditions.

Burgerjon and P. Grison (Biological Control Laboratory at La Minière) experimentally investigated the susceptibility of 25 species of Lepidoptera, including the cabbage butterfly, gypsy moth, European corn borer, leaf rollers, etc. to the "Anduze" strain of B. thuringiensis. It appeared that their susceptibility to infection differed greatly; in particular the interesting fact came to light that even closely related species are sharply distinguished by their susceptibility to infection by B. thuringiensis. The cabbage butterfly, a sphinx moth, Thaumatopoea processionea L.,

and Dendrolimus pini L. where very susceptible, while the gypsy moth and several noctuids were not susceptible.

A. Krieg (Biological Control Institute of the FGR) isolated strains of B. thuringiensis from various hosts (Euxoa segetum Schiff., Ephestia, Galleria, etc.). It appeared that isolated strains are pathogenic only against certain species of Lepidoptera and not at all pathogenic to beetles and hymenoptera. That which is effective against the cabbage butterfly is not effective against the codling moth. The same holds for the clothes moth and wax moth. Different strains of B. thuringiensis are specific for different hosts.

B. Hurpin (La Minière) carried out analogous work in connection with the milky disease pathogen in white grubs. He compared local strains of Bacillus popilliae Dutky from the Japanese beetle, B. lentimorbus var. australis Beard from Australia, and several others. It appeared that only local strains of the pathogen were pathogenic to the May beetle after active oral infection.

The subsequent section was devoted to the histopathology of Tipula paludosa Mg. after infection by rickettsiae, was represented by the papers of A. Huger (Biological Control Institute in the FRG). The histopathological picture of the disease was investigated by examining cross sections of larvae raised in the laboratory and artificially infected orally. The disease became clearly apparent sometimes as long as 30 days after infection. The fat body and several other tissues (the gut musculature, tracheal matrix, epidermis) are subject to intensive injury. Characteristic of rickettsial infection is the widespread presence of rhomboidal crystals. The affected cells are strongly hypertrophied as a rule. Transmission to the offspring via the egg is not observed. Individuals infected in the laboratory do not differ noticeably from those naturally infected and collected in the field.

Madame N. Dumas (Pasteur Institute) and Hurpin studied rickettsial localization in detail. They found rickettsiae in the hemocytes as well as in the tissues mentioned above.

The above authors and P. Giroud experimented with raising rickettsiae from white grubs in the hemolymph of white mice. The experiment was partly successful, but the authors thought that there was little possibility that the rickettsiae could develop in the gut of the mice after these had eaten diseased May beetle larvae.

Krieg (Biological Control Institute, FRG) investigated the nature of the crystalloid inclusions in cells after rickettsial injury in May beetle, Japaneses beetle, and tipulid larvae. A chemical analysis showed that the crystals are proteins. Similarities are apparent between these protein inclusions and the albuminoid granules of the fat body. As the crystals formed by the ricketsiae grow, the albuminoid granules in the fat body of the host become reduced. Of the amino acids, the most obvious role is played in these processes by tyrosine and phenylalanine. The crystalloid formations of the rickettsiae do not contain nucleic acids.

Hüger (Biological Control Institute, FRG) undertook histological investigations on the origin of the crystals after rickettsial infections of Tipula paludosa Mg. larvae. There have not been any data on this problem up to the present time. It could only be shown that several stages in this development were closely associated with the transformation of the albuminoid granules in the fat cells of the host.

E. Müller-Kögler (Biological Control Institute, FRG) isolated pure strains and experimented on the laboratory culture of entomogenous fungi which play a major role in the mycoses of insects. It is of practical importance to resolve the problem of artificially inducing massive infections of insects by entomogenous fungi. He successfully solved this problem. Among other media sterilized milk was used as a food medium. Mycelia developed on the surface of the milk. The culture may be preserved for two to four months. The most favorable media are mixtures of milk, yeasts, and agar, milk and agar, meat extract, yolk and agar, and a medium made from potato sprouts. The ability to obtain and maintain pure laboratory cultures of entomogenous fungi also enables one to solve several difficult taxonomic problems.

On insect viruses several papers were presented which were devoted to the histopathological picture of the diseases and the microbiological characteristics of the pathogens. Müller-Kögler carried out experiments on infecting Tipula paludosa Mg. by polyhedral viruses collected from this host. Feeding polyhedra to fourth instar larvae did not result in infection. However, at the same time the virus infection appeared spontaneously. The author proposed that infection occurred earlier (at the earliest larval instars). Artificial infection was induced by offering food into which rickettsial pathogens had been mixed. Under these conditions the incubation period lasted from $5\frac{1}{2}$ to 11-12 weeks. Such indefinite results with artificial infection with the virus pathogen the author attributes to differences in the virulence of the pathogen and the resistance of the host.

C. Vago (Laboratory of Cellular Pathology in Alès) carried out interesting investigations on artificial tissue culture in insects. This sort of experiment is essential for the study of virus diseases of insects. Experiments on the artificial laboratory culture of insect tissues have been successfully performed only very recently. The author succeeded in observing the development of a virus from one species of insect in the cells of another species. The virulence of a virus when artificially cultured in different tissues of an insect was investigated.

K. Aizawa (Japanese Associate at the Laboratory of Cellular Pathology in Ales) carried out analogous experiments with tissue cultures of Lepidoptera in artificial media. He confirmed the possibility of culturing insect tissues. He succeeded in tracing the formation of virus bodies. Three different strains of Borellina virus, obtained from silkworms, were used for infection. His experiments showed that under laboratory conditions in artificial tissue cultures it is possible not only to observe pathogenesis by Borellina virus but also to investigate the virulence of the artificially reproducing virus. After transplanting polyhedral virus from silkworm to chick embryos Aizawa observed definite regular transformations in the shape of the polyhedra.

D. Martouret (Laboratory of Biocoenology and Biological Control at La Minière) experimented with the artificial multiplication of polyhedra obtained from Thaumatopoea processionea L. and used these for a field experiment on the control of this pest in an area of 250 hectares. About 200,000 caterpillars were collected to accomplish this. Of these about 170,000 were artificially infected and used as pathogenically active material The hemolymph was pressed out of the infected caterpillars and the suspension thus obtained was filtered through nylon filter. In 83 liters of filtrates there were about three thousand million polyhedra per cubic centimeter. The extract was then mixed with 10 tons of inert material (clay) and distributed by helicopter for biological control. The author also carried out various experiments on the use of B. thuringiensis for control of Pieris rapae L. The formulation was prepared in two ways: as a liquid for spraying (1,400 liters per hectare with an activity of 900 units per mg) and as a powder (in the latter case about 30 kg per hectare were applied). The possibility of residual effect was shown (by means of an artificial rain of 3-9 mm). Using these same formulations, experiments were carried out on the control of Thaumatopoea processionea L., Sparganothis pilleriana Schiff., European corn borer, and several others. The bacilli proved to have an effect against other, beneficial elements of the biocoenose, in particular the entomophagous insects and bees. The harmlessness to bees of the "Anduze" strain of B. thuringiensis was established.

Burgerjon and K. Klinger (Laboratory of Biocoenology and Biological Control at La Minière) experimented on determining the most favorable time for applying B. thuringiensis against Sparganothis pilleriana Schiff. (eight different application times with three different formulation concentrations). They determined the optimal concentration. The most suitable time for the introduction of the bacteria was immediately after the hatching of the larvae.

E. N. G. van Damme and Van der Laan (Laboratory of Forest Entomology at Amsterdam University) made observations on the effect of a powder preparation of B. thuringiensis on caterpillars of Malacosoma neustria L. Caterpillars were reared in insectaries and bacterial dust was sprinkled over them After 10 days mortality among the caterpillars was 90-95% versus 0-5% mortality in the controls.

Grison, M. Maury (Laboratory of Biocoenology and Biological Control at La Minière), and Vago treated an area infested with Thaumatopola processionea L. with a preparation of "Smithiavirus". Three hundred hectares were treated in October of 1958; about 10 tons of virus-containing powder were used for this purpose. The results of the experiment will be determined in the spring of 1959.

M. Billiotti (Director of the Agricultural Station at Antibes) made ecological observations over several years on the course of diseases in Thaumatopoea processionea L. in different biotopes in France and Corsica and attempted to determine the relative importance of microbiological factors among the other factors. It turned out that fungal, bacterial, and virus diseases played unequal roles in the different biotopes.

In the concluding session Müller-Kögler and Hüger discussed the problems of diagnosis of disease in various insects when these are attacked by various microbiological agents.

C. Vago (Laboratory of Cellular Pathology in Alès) concluded with an interesting talk on the characteristics and complications in the disease pattern when infection is by several pathogens of different diseases. In nature, as a rule, the population supports the etiologic agents of not one, but several, diseases. The final outcome depends on the interaction of the specific external environmental conditions in a given place, the varying potencies of the pathogens, and the varying degrees of immunity in the different populations and individuals composing them.

Individual etiologic agents could act upon an insect as synergists or as anatagonists, that is, they could strengthen or weaken virulence and pathogenicity. The factors resulting from the complex influence of the different entomophages on the insects in complex ecological conditions require a preliminary multilateral biological investigation.

As a rule all talks were illustrated by culture samples, maps, diagrams, tables, and excellent colored and monochrome photographs. For demonstrations universal-purpose projectors were used; these are extremely compact and suitable for handling.

The discussions often led to questions and short answers.

The form and content of the papers attested to the fact that the investigations were carried out at a high procedural level using the most modern and precise research methods. The subject matter was largely of a specialized nature and was related to several general microbiological problems. However, the problems resolved were closely tied to practical questions of microbiological control methods against insects. These are not general academic research problems but primarily those which are needed for the practical adoption and utilization of entomophagous microorganisms. In this close association and coordination between high procedural methods in the solution of specialized microbiological problems and the practical needs of entomology, in the cooperation between theoretical work at La Minière and the Pasteur Factory-Institute, the most nearly characteristic feature is the outstanding and original nature of the research work at the Laborartory of Biocoenology and Biological Control at La Minière.

The resolutions of the session are very short,and at first sight not closely connected with the contents of the papers presented at the conference; however they reflect the hopes and aspirations of the C. I. L. B. They consist of three main themes: 1) to strengthen and develop the ties between the C. I. L. B. and corresponding organizations on biological control in the countries of the people's democracies of Europe and Asia; 2) the Committee of the C. I. L. B. considers it essential to hold a conference in February of 1959 between representatives of the C. I. L. B. and analogous organizations in the countries of Eastern Europe in accordance with the wishes contained in the resolution of the First Internationl Conference on Insect Pathology and Biological Control which convened in Prague in August of 1958; 3) the following membership of the Executive Bureau of the C. I. L. B. was approved in a session of the conference held in Prague in October of 1958: General Secretary P. Grison, Vice-presidents D. Franz and F. Schneider.

A second,no less important, duty of the author of this report was to acquaint himself with the organization of other institutes, an account of which follows.

The functional equivalent of our VIZR in France is the Laboratory of Plant Pathology under the National Institute of Agronomic Research under the Ministry of Agriculture. It has two principal sections: phytopathology and zooentomology. The latter is headed by Prof. Trouvellot. The zooentomology section is located in the environs of Versailles in the park zone in a spacious two-storey building. There is a total of about 12 workers here, of which seven are scientists. There are about 40 entomologists in the entire organization. The working facilities are roomy, with few people but with a profusion of equipment, furniture, cages, optical equipment, and cabinets with glassware and chemicals. The animals studied are of secondary importance by our standards: mites on urban ornamentals, leaf-beetles on crucifers, Phytometra gamma L., Mediterranean fruit fly, collembola in the surface stratum, strawberrypests, etc. The subject matter is mixed: from studies of photoperiodism to the elaboration of control measures. However, even the theoretical investigations are oriented towards the solution of practical problems.

The Laboratory of Biocoenology and Biological Control at La Miniére is under the same Institute of Agronomic Research. The laboratory was created very recently (in the last three or four years); its construction has not yet been completed. The reasons for the creation of this laboratory were the successes achieved in biological control in Canada and the United States of America,and the disappointments following the widespread application of the highly toxic organic insecticides (DDT, BHC, etc.). Its relationship to the Laboratory of Plant Pathology, headed by Prof. Trouvellot, is that of a more advanced stage, differing from it in the specialized nature of its research in ecology and on microorganisms for biological control purposes. In connection with these new purposes, the laboratory is lavishly equipped with modern equipment which enables the investigations to proceed at a high technical level. The laboratory at La Minière, which is now headed by Dr. Grison, is a modification of the analogous laboratory of Prof. Bergold in Canada. A similar laboratory is being constructed in Antibes with minor modifications suitable for the study of entomophagous insects. A third analogous station in France is located in Alès and is called the Laboratory of Phytopathology.

The Laboratory of Biocoenology and Microbiological Control at La Minière is one of the most modern in technical equipment of any similar laboratory in Europe. The laboratory occupies an area of about 10 hectares, most of which is occupied with experimental plots of vegetable crops and gardens. There are about five brick buildings distributed on this land and a series of greenhouses and insectaries. The principal laboratory installations are situated in two single-storey (for economy) buildings with basements. They are similar in structure and the second, as yet incompleted, building consists only of an improved and roomier duplication of the first. These buildings were especially constructed for the purpose of conducting entomological work. It is therefore interesting to consider their plan.

The laboratory buildings consist of elongated brick structures with many large windows. The extensive veranda-insectary makes up the right portion of the building. The walls of the entrance hall serve as shelves for books. The office of the director and secretary are at the side of the entrance hall. In each building there are three or four laboratories, a washing and sterilizing room for the disinfection of materials, a quarantine room, a room for the reception and preliminary treatment of material, a breeding room, three double rooms with artificial climate, a measuring and weighing room, a "micromanipulation" room, a large room for treating material, a room for keeping strains of disease pathogens, and a dark room. The cabinets containing glassware, optical instruments, and materials are usually arranged near the ceiling along the walls, which is at first glance inconvenient, being due to considerations of economy of space and funds. The working facilities are generous and provided with all essentials: convenient tables, constant temperature chambers, card indices, optical instruments, special apparatus for different types of research on microorganisms, glassware, and materials (reagents, media, etc.). Glassware has been extensively replaced by plastic ware. This is cheaper and more convenient for handling. For specialized entomological purposes different types of standard household ware, serially produced by industry, are used: bottles, cylinders, cans, and cups of various shapes and sizes. Minor changes can make them perfectly suitable for the specialized purposes of entomological and microbiological work. There are special burners and heating apparatuses for cutting and fusing plastic objects. Wire screening has been replaced by a glass screening, the individual strands of which consist of tubes of a refractory material containing a glass filament. This sort of screen is easily cut by scissors and is very easily and simply attached to plastic ware. The walls and floor are either painted in special light colors or are made of concrete because of the necessarily high humidity conditions. Storage facilities, the disinfection chamber, garage, and dining room for the laboratory workers are found in a separate brick structure situated nearby. Not far from here are the cabins for the gardeners. The chambers are very simply and cheaply constructed with temperature and humidity regulation. Heating and constant ventilation is controlled by a modern relay, while the humidity regulating apparatus is adopted from that used in the textile industry. In the low temperature room refrigerators used in the food industry are employed as refrigerating apparatuses. With the exception of the optical instruments and occasional specialized and very complicated apparatus (for instance, those used for the standardization of the dosage of microbiological preparation to be applied to the surface of the leaves to be eaten by insects), the majority of the elements with which the laboratory is equipped is adapted from standard materials and standard products put out by the developed industry. The laboratory and especially the artificial climate chambers are lighted by fluorescent lighting which excludes or minimizes infrared heat radiation. Eight fluorescent lamp bulbs each of 40-watt capacity are used in the laboratory chambers at La Minière. The staff of this spacious and comprehensively equipped establishment consists of four research workers, comprising the entire scientific personnel of the institute, and eight laboratory assistants. The director of the station has two secretaries, and there are in addition two charwomen and three gardeners. As may well be imagined, there is a car and chauffeur.

The type of work that is being done in this institution may be judged on the basis of the papers listed above. Of special interest in the areas not represented in the talks is the extensive work being done on the selection of food for the artificial rearing of May beetle larvae in the laboratory. The numerous simple and convenient devices, such as the following, which are used for the rearing and keeping of insects, deserve to be introduced into our practices: cages with removable sides for keeping Lepidoptera and having them lay eggs on the gauze, glass and plastic screening in the soil under the cages of soil-inhabiting larvae, special devices for feeding Lepidoptera, compressed-air apparatus used for drying glassware, and many more.

The principal field of research in this laboratory is the study of the systematics, biology, and ecology of bacteria and viruses and the ecological relationships of various insect pests of France, and also the testing of the virulence and pathogenicity of various strains of prospective disease pathogens for biological control purposes. The principal insects studied are the various bombicoid pests (Thaumatopoea, etc.), notodontids, and orgyids.

An interesting system is used in the station to observe and control current work which has been projected and organized by the research workers and which is being carried out in practice by the laboratory assistants. The latter write on the blackboards, which are hung in the corridor, the current progress and all essential data on the experiments being carried out (the number and condition of the experimental insects, temperature and humidity conditions, type of feeding, and so forth). In this way the supervisor can at any moment gain an impression of the state of the work he is carrying out without taking up the time of his associate or of himself in the process. At the same time the laboratory assistant has more feeling of consciousness and responsibility toward the task allotted to him.

BOOK REVIEWS

A. I. Cherepanov. Elaterids of West Siberia. West Siberian Branch of the Academy of Sciences, USSR. Novosibirsk, 1957, 380 pp. Edition: 500 copies. Price: 26 r.

This work of A. I. Cherepanov is divided into two sections – a general and a systematic one. The first section comprises chapters on the history of faunal investigations, the distribution of the fauna by ecological zones, zoogeographical subdivisions, the zoogeographical aspects of the elaterid fauna, ecological and biological characteristics of the elaterids of west Siberia, their injurious activity, and methods of controlling them. The second section includes descriptions of the beetles and keys to the adults and larvae.

The history of faunal investigations is examined in detail, beginning with the 17th Century. This includes a survey of all the faunistic investigations carried out in west Siberia, and a critical discussion of the literature sources which are to any extent devoted to the elaterids of west Siberia.

The author examines in even greater detail the history of faunal investigations in west Siberia since the time of the Great October Revolution, after which the number of investigations and the tempo of research greatly increased in comparison with the previous period. The personal investigations of the author began in 1947 and continued through the last few years. He undertook a number of expeditions and also some stationary work on the fauna, phenology, geographical distribution, and economic importance of this group in west Siberia. It should especially be pointed out that the author carefully examined these factors with regard to the larvae of elaterids, presenting much interesting and original data (for instance, on the movement of larvae, determined by the use of trace elements).

This work is a genuine contribution based primarily on personal investigations, and also on a critical analysis of literature data and an examination of collected material in all the principal museums of Siberia, the Zoological Institute of the Academy of Sciences, USSR, the Zoological Museum of Moscow University, and the Institute of Plant Protection of the V. L. Lenin Academy of Agricultural Sciences.

The chapter on the distribution of elaterids by ecological zones examines the ecological associations of the tundra, forest-tundra, level taiga, forest-steppe, steppe, montane-forest, and montane-alpine belts. Each of the habitats named is characterized by climatic and vegetational features. For each zone he does not present a total list of the species found within it, but discusses even smaller subdivisions (associations or stations) for each of which a species list is presented. This ecological differentiation, with an estimation of all the intra- and extrazonal factors involved, is interesting from the point of view of the formation of biocoenoses in ecological zones, but it also enables one to evaluate the practical importance of these small groupings of elaterids. For instance, if we take the forest steppe zone, which is characterized by the greatest diversity of species, we may clearly see from its description not only its general characteristics and all subsidiary aggregates (species inhabiting birch-aspen associations, various types of pine forests, steppe-meadows, and open fields), but we may also understand the entire process of ecological interrelationships between the latter, and the formation of aggregates associated with agricultural crops.

The third chapter discusses the problem of zoogeographically subdividing west Siberia on the basis of the distribution of elaterid faunal complexes. It should especially be emphasized that the author does not make his subdivisions on the basis of the distribution of individual species, but rather of ecological aggregates of species, thereby avoiding formalism in his divisions, endowing them with a certain reliability, and, since they are partly natural, enabling them to be used for practical purposes.

The author remained faithful to ecological principles even in his examination of the historical formation of the elaterid fauna. Basing his conclusions on the presence of certain faunal elements, he examines the latter

in relation to definite ecological zones. This chapter, although short, is convincingly presented. The author correctly traces the steps in the formation of the elaterid fauna of west Siberia, which is distinguished by an absence of endemicity and which has derived its elements from the surrounding Palaearctic centers (the Angara, Altai, Central Asian, and European centers).

The author devotes much of his monograph to the ecological and biological characteristics of this group of beetles and their larvae. The most original of his investigations are set forth in this part of the book. By means of numerous observations and experiments the author has clarified the importance of light, temperature, and humidity in the life of elaterids, thereby making it possible to understand the qualitative and quantitative dynamics of different species in their microhabitat, and their behavior at different times of day, or in different soil layers (in the case of the larvae). Especially careful experimental observations were carried out on the growth and duration of larval development and movement in the soil. Much new information was obtained by the author on the development of elaterid pupae.

The book also presents new data on the parasites and predators of elaterids. Besides the known insect predators, (carabids, Hymenoptera, and flies) and mites of the genera Tyroglyphus and Tyrophagus, a long list of birds and some mammals (shrews and moles) are shown to eat elaterids. This was determined by analyzing the stomach contents of these vertebrates.

By giving examples of the morphological adaptations of elaterid larvae the author was able to supplement the well-known investigations of M. S. Gilyarov on adaptations of soil inhabitants. As a thorough field investigator, A. I. Cherepanov could not avoid noticing the presence of ecological forms of elaterids in nature; these forms were distinguished by their phenology, habitat, and even morphology. Thus in Corymbetes cupreus F. he found different forms in the plains, forests, forest tundra, and montane-alpine belts of the Altai and Sayan.

The chapter on "Injurious activities of elaterids and means of controlling them" is the fullest account to date of the results of investigations on the resistance of agricultural plants to injury by wireworms in Siberia. The same chapter gives data on losses caused by wireworms, and emphasizes the particularly extensive damage caused to potato and Indian corn. At the end of the chapter there is a discussion of the possible control measures approved by the author, who determined that, after trying all cultural control measures, treating the soil by the method of T. S. Mal'tsev creates unfavorable conditions for wireworms, while crop rotation with pasturage prevents accumulation of the larvae in the soil.

The second half of the monograph contains detailed descriptions of the different species of elaterids and their larvae (eight species and one subspecies are described as new to science). There are keys to the subfamilies, genera, and species. The description of nearly every species is illustrated with figures of the entire imago and morphological details of the larvae. Distribution maps are given for several species. All this greatly facilitates the use of the book.

At the end of the monograph a resumé is given in German and an extensive bibliography of both Soviet and foreign works is presented.

On the whole A. I. Cherepanov's book discusses all the fundamental questions which should be dealt with in a good regional revision of the fauna of our Union. Its appearance should be welcome in every way. There is no doubt that it will not only serve as a manual for specialists studying the fauna of west Siberia, but will also be of great help to agronomists and foresters in their practical work.

A. I. Kurentsov

O. W. Richards. Hymenoptera. Introduction and Keys to Families. Handbooks for the Identification of British Insects, Vol. VI, part 1, pp. 1 94, 197 + XXII figs. Royal Entom. Soc. London. 1956.

The Royal Entomological Society of London is presently publishing a series of short manuals for the determination of British insects. The insect fauna of England is probably more completely known than that of any other country in the world. This is not only because of her comparatively small territory, the insular and boreal position of the country and its consequently not very rich fauna, but especially because of its long and thorough study by numerous British entomologists, both professional and amateur, and their intense devotion to the natural history of their country.

The ways by which British entomologists have solved the problem placed before them is of interest. A total of 10 volumes is projected. Each volume is to consist of separate issues. Of these volumes two are devoted to the Diptera, two to the thoroughly studied Coleoptera, and three to the insufficiently studied Hymenoptera. The issue written by Richards begins with the opinion that in Britain the Hymenoptera are the largest order in number of species, although not all of its families have been sufficiently studied there. It is suggested that the composition of several groups of ichneumons could be double that presently known.

Beside the first part of Volume VI here reviewed, by the end of 1957 the following parts had already been printed, as far as we know: I (2) – M. J. Delany (Thysanura and Diplura); I (5) – W. D. Hincks (Dermaptera and Ortoptera, 2nd ed.); I (6) – D. E. Kimmins (Plecoptera), I (9) – D. E. Kimmins (Ephemerida), I (10) – F. C. Fraser (Odonata, 2nd ed.); I (16) – F. Smith (Siphonaptera); on beetles: IV (1) – R. A. Crowson (Introduction and key to species), IV (3) – F. Balfour-Browne (Hydradephaga); IV (8a) – C. E. Tottenham (Staphylinidae, part); V (7) – R. D. Pope (Coccinellidae and Sphindidae), V (9) – F. D. Buck (Lagriidae to Meloidae); V (11) – E. B. Britton (Scarabaeidae); V (12) – E. A. J. Duffy (Cerambycidae); V (15) – E. A. J. Duffy (Scolytidae and Platypodidae); on Hymenoptera: VI (2, 2b) – R. B. Benson (Chalastogastra, in 2 parts); on Diptera: IX (1) – H. Oldroyd (Introduction and key to families, 2nd ed.), IX (2) – R. L. Coe, P. Freeman, P. F. Mattingly (Nemocera, in part); X (1) – R. L. Coe (Syrphidae); X (4a) – F. I. van Emden (Cyclorrhapha, in part). Volumes VI (Chalastrogastra and Aculeata), VII (Ichneumonoidea), and VIII (Cynipoidea, Chalcidoidea, and Serphoidea) will be devoted to the Hymenoptera.

The part under consideration is by one of the most authoritative entomologists of Britain – O. W. Richards. Professor Richards has worked long and productively in the field of both the systematics and biology of various groups of Hymenoptera, as well as in insect ecology. The issue is written in a very concise form and contains almost no introductory remarks. It includes an outline of the comparative external morphology of Hymenoptera, a short outline of their biology, keys to suborders, superfamilies, and families, short remarks on the phylogenetic relationships of the families, lists of terms and abbreviations, a very short survey of the literature on British Hymenoptera, and a list of the works cited in the text (71 citations). The book is provided with 196 schematic illustrations of parts of the body of Hymenoptera and 22 over-all views of representatives of families.

For the nomenclature of body parts the author uses the terminology of Snodgrass; the designation of the veins and cells of the wings is based principally on Ross's (1936) system, which has been adopted by many American entomologists at the present time. In addition, the book adopts the customary terminology which is used in some groups (for instance, in the naming of parts of the intermediate segment in Ichneumonidae and Pteromalidae, and in the designation of several veins and cells). Definitions begin with the most elementary terms, which means that the book is very useful for beginners. Particularly interesting are the data on the number of spiracles on the abdominal segments and the keys to the families (females and males) on the basis of the structure of the apical abdominal segments. The problems discussed in greatest detail (from their taxonomic importance) are the five types of hypostomal anastomoses, the wing venation (here the author analyzes the feature of wing venation of species in the different families), and the structure of the abdomen. There is a useful, although not original, comparative table of principal terms used in designating the various parts of the copulatory apparatus of the female, according to Snodgrass and other authors.

The short outline of the biology of Hymenopteradeals with the relationships of the sexes, oviposition, larval constructions, food relationships, nidification, variability, and other problems. The author emphasizes the absence of fundamental structural and functional differences between the Parasitica and the Aculeata, quoting O. M. Reuter's opinion that most of the so-called parasitic Hymenoptera should be considered perfected predators and called "parasitoids". The factors in favor of this, according to the author, are their mobility and the preservation of fully developed sense organs, which have a tendency to disappear in such true parasites as the lice; furthermore, the adult insects are not in close association with the host, which the larva nearly always kills. However, the author does not insist on the adoption of the term "parasitoid". Speaking of the closeness of the Aculeata to the Parasitica, he calls the reader's attention to instances of predation in the Parasitica (Tromatobia, Evaniidae, Gasteruption assectator) and of parasitism in the Aculeata (Bethylidae, Dryinidae, Tiphiidae, Sapygidae, Mutillidae, Cleptidae, and others).

The very clear TablesI to III summarize all information on the parasitic Hymenoptera of the British fauna and their hosts. Table I gives information on the systematic position of the parasitic genera of aculeates and their hosts, which belong to the same family, and sometimes even to the same genus; this table would gain in usefulness if it showed not only the generic but also the specific relationships of parasite and host. Table II presents data on the hosts (and their systematic position) of British Hymenoptera Parasitica, while TableIII gives information on the systematic position (to family) of the prey with which higher predatory Hymenoptera provide their offspring. These tables admirably illustrate two things: first, the known obligatory biological ties existing between the Hymenoptera on the one hand and the Arachnida, Diplopoda, Chilopoda, and other orders of insects on the other and, second, the biological ties existing within the order Hymenoptera itself. They clearly explain why it is possible for such a rich hymenopterous fauna to exist in Britain.

It is unfortunate that the author did not include a similar summation of the principal information available on obligatory relationships between phytophagous forms and the plants they eat, between Hymenoptera developing in plants and the species injured by them, and between oligotrophic pollinators and the flowers they pollinate. This would have set forth the biological relationships of British Hymenoptera even better.

The book ends with a list of the terms and abbreviations adopted by the author and always cited in contracted form in the text; a separate list gives the designations of the cells and veins of the wings. A separate index contains information on the suborders and families followed by morphological and other matter, and also several general biological terms.

A fault of the book is the absence of an expressed and supported system of classification of the Hymenoptera, which means that one has to judge the author's classification primarily from the keys for the determination of families. Following the American authors the order is divided into two suborders – the Symphyta and Apocrita, with the latter divided into two sections – the Parasitica and Aculeata. Hence, since there are no clear fundamental distinctions between the Parasitica and Aculeata, this classification is more acceptable than the division of the Hymenoptera into three suborders – Symphyta, Parasitica, and Aculeata.

The suborder Symphyta is divided into the following superfamilies: Xyeloidea (fam. Xyelidae), Megalodontoidea (fam. Megalodontidae, Pamphiliidae), Siricoidea (fam. Siricidae, Xiphydriidae), Orussoidea (fam. Orussidae), Cephoidea (fam. Cephidae) and Tenthredinoidea (fam. Argidae, Blasticotomidae, Cimbicidae, Tenthredinidae, Diprionidae). The section Parasitica is divided into six superfamilies: Evanioidea (fam. Evaniidae, Aulacidae, Gasteruptiidae), Trigonaloidea (fam. Trigonalidae), Ichneumonoidea (fam. Ichneumonidae, Braconidae), Proctotrupoidea (fam. Proctotrupidae, Platygasteridae, Scelionidae, Diapriidae, Heloridae, Ceraphrontidae), Cynipoidea (fam. Ibaliidae, Figitidae, Cynipidae) and Chalcidoidea (fam. Chalcididae, Mymaridae, Elasmidae, Eulophidae, Trichogrammatidae, Eupelmidae, Encyrtidae, Thysanidae, Eucharitidae, Torymidae, Ormyridae, Pteromalidae, Eurytomidae, Perilampidae). Agriotypus is included in the Ichneumonidae, the Aphidiidae are placed in the Braconidae as a subfamily, the Belythinae are included in the Diapriidae, the Eucoliinae and Anacharitinae are included in the Figitidae, and the Charipinae in the Cynipidae. Of the 23 Palaearctic families of Chalcidoidea (according to M. N. Nikol'skaya's classification, 1952) some members of which could be found in Britain, the author of the handbook recognizes only 14. It is difficult to object at the present time to inclusion of the Elachertidae, Entedontidae, and Tetrastichidae in the Eulophidae because the problem has not been sufficiently studied, but it is impossible to agree with treating the Aphelinidae as a subfamily of the eulophids, even though this is done by several American authors. The aphelinids are possibly related to the eulophid complex of families in the Chalcidoidea, but they are clearly separate from it on both morphological and biological grounds, being an independent

and highly specialized group of chalcids in many ways convergent with the encyrtids. The family Pteromalidae is also too broad in this author's concept. Generally speaking, chalcid specialists have not yet worked out any agreed principles for subdividing the chalcids into families; it would be desirable for the chalcid families to be represented as fully as possible in manuals. This would facilitate literature work for beginners.

The author divides the section Aculeata into the following superfamilies: Bethyloidea (fam. Dryinidae, Embolemidae, Bethylidae, Chrysididae, Cleptidae), Formicoidea (fam. Formicidae), Vespoidea (fam. Vespidae), Pompiloidea (fam. Pompilidae), Sphecoidea (fam. Sphecidae), Scolioidea (fam. Mutillidae, Sapygidae, Tiphiidae) and Apoidea (fam. Andrenidae, Halictidae, Colletidae, Melittidae, Megachilidae, Apidae).

Thus the classification of the Hymenoptera adopted in the handbook being reviewed differs fundamentally from the generally adopted modern American system (Muesebeck et al., Hymenoptera of America, North of Mexico, 1951). The authors of the British handbook justifiably recognize the superfamilies Xyeloidea, Orussoidea, Evanioidea, Formicoidea, and Pompiloidea, the family Aulacidae, and so forth. The key to the families concludes with a short section – "Interrelationships between the families of Hymenoptera." Here in 14 lines the criticism and scepticism of the author reaches its apogee. The author's remarks are indisputable, but a more detailed and profound analysis would undoubtedly be desirable.

The introduction to the "Hymenoptera" is written in very clear and concise language; the presentation of the subject is up-to-date, scientific, and discriminating. Even if it is a model of popular presentation, it is meant for the biologically well-grounded reader, the entomological specialist, student, doctor, and biologist.

The publication of this sort of highly competent and portable handbook for the determination of insects is of great and far-reaching practical significance and represents a very fortunate achievement of British entomologists. Such an achievement is the introduction to the study of Hymenoptera here being reviewed.

As was already mentioned at the beginning, the first part of the handbooks consist of 10 volumes; the number of parts is apparently not always exactly determined. The second volume devoted to the beetles already numbers 15 parts, according to the announcement; their size varies. Part 2 of volume IX, devoted to part of the Nematocera, has more than 200 pages of text. Thus, the over-all bulk of the edition, in spite of its great conciseness, is not so small.

The British publication pursues the same aims as do the "Opredeliteli po faune SSSR",* published by the Zoological Institute of the Academy of Sciences, USSR, with regard to the fauna of the Soviet Union, although the latter are not so restricted in form. The size and number of the entomological volumes and issues of the Opredeliteli (handbooks for determination) demonstrate the extent to which this task is augmented and complicated for any territory of the Soviet Union, in comparison with Britain. Part 5 of volume I of the British publication, devoted to the Dermaptera and Orthoptera, numbers only 24 pages (58 species); two volumes of the Opredeliteli by G. Ya. Bei-Bienko and L. L. Mishchenko, devoted to the grasshoppers only and also greatly compressed in size, number 667 pages of text (comprising 883 species, of which 481 were previously known from the USSR). Whatever the difference in size and number of species of Hymenoptera may be in comparison with the British publication, it is impossible to deny that in this respect the USSR fauna has been studied even more inadequately.

V. V. Popov and V. A. Tryapitsyn

* "Determination of the Fauna of the USSR."

A.I.B.S. Russian Monograph Translations

The AIBS is in the process of expanding its Russian Translations Program extensively. Funds to subsidize translation and publication of important Russian literature in biology have been obtained from the National Science Foundation, as part of a larger program to encourage the exchange of scientific information between the two countries. The following monographs have been published:

Origins of Angiospermous Plants. *By A. L. Takhtajan.*
Edited by G. Ledyard Stebbins. Translated by Olga H. Gankin.
68 pp. $3.00 (U.S. & Canada) $3.50 (Foreign)

Essays on the Evolutionary Morphology of Plants. *By A. L. Takhtajan.*
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